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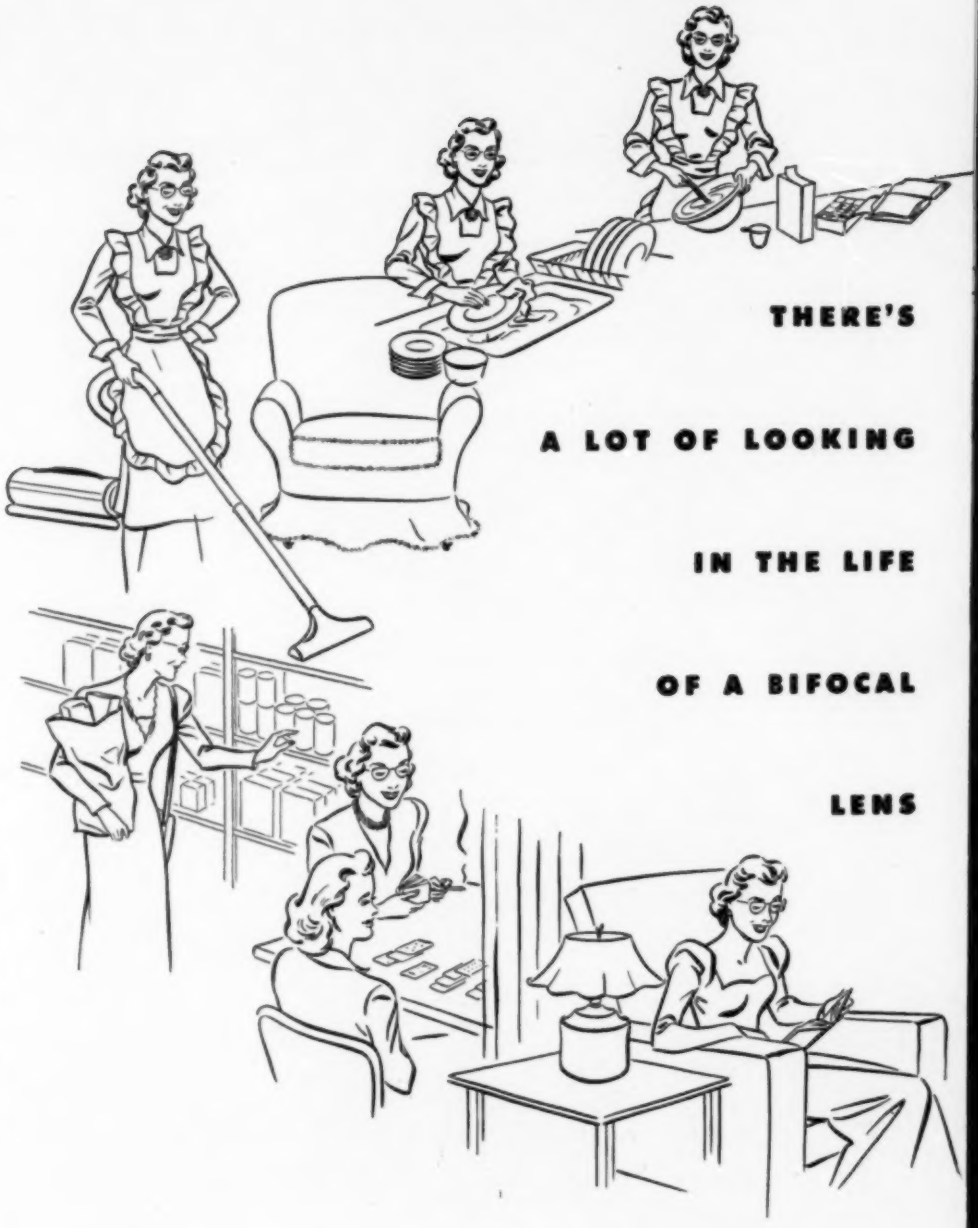

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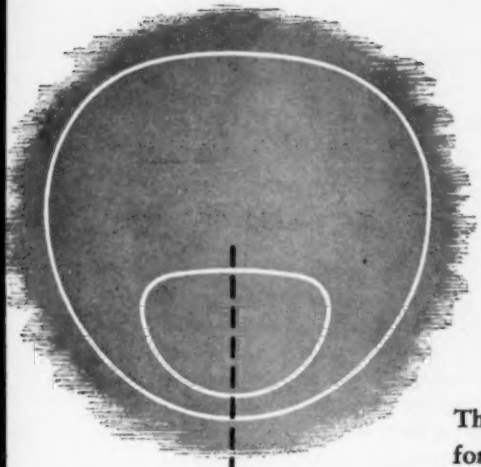

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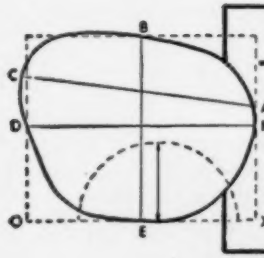

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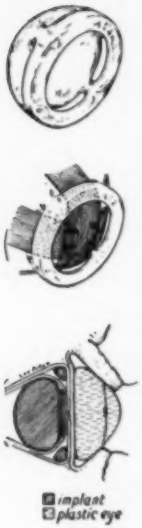

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Vol. 28 July, 1951 No. 7

FACTORS RELATED TO MONOCULAR AND BINOCULAR READING EFFICIENCY*

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Reading Clinics, University of Chicago
Chicago, Illinois

Since 1938 when the Gray Oral Reading Check Tests[1] were adapted to the Keystone telebinocular for the purpose of measuring monocular and binocular reading efficiency, optometrists and educators have frequently assumed that any difference in performance on these tests is significant. Therefore, the need was urgent to determine whether these tests were discriminative, and if so, whether the results were related to other factors such as visual efficiency, and eye preference. The assumption had been made that the results of these tests were closely related. The research reported on the following pages was carried out to test this assumption.[2]

Summary of previous investigations. In 1940, Frazer, Ogden, and Robinson[3] tested 80 college students with Set IV of the Gray Oral Reading Check Tests using the telebinocular. Only the eye with the better visual acuity was tested for reading, and the results were compared with binocular reading. The authors concluded that this test had little value for college students since the correlation of monocular and binocular tests was higher than either of the two monocular or binocular scores

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*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 17, 1950. For publication in the July, 1951, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Director of Clinic. Ph.D. Fellow, American Academy of Optometry.

1. *Keystone Tests for Binocular Skill*, an adaptation of the Gray Oral Reading Check Tests for use in the Keystone telebinocular, by William S. Gray. Meadville, Penna.: Keystone View Co.

2. Staff of the Reading Clinics of the University of Chicago. "Clinical Studies in Reading I." *Supplementary Education Monographs*, No. 68, June, 1949, Chicago: University of Chicago Press, p. 97-112.

3. Jane Frazer, Jean Ogden, and F. P. Robinson, "The Testing of Binocular and Monocular Oral Reading Skill," Journal of Educational Research, XXXIII (March, 1940), 528-30.

alone. However, the investigators overlooked the fact that the performance of the eye with poorest acuity might be significant.

Gahagan[4] studied eye dominance and visual acuity using the McCollie Vision Test to determine acuity and sighting through a hole in a piece of cardboard to determine the dominant eye. His subjects were 100 college students. Only 55 per cent of his subjects preferred the eye with best acuity.

Spache[5] considered eye preference, visual acuity, and reading ability. Eye preference was measured by the Binocular Reading Test,[6] designed so that when viewed in a stereoscope, 20 words in running context appear before the right eye only and 20 others appear before the left eye alone. His measure of visual acuity was not reported. Reading was tested monocularly and binocularly with the Check Tests. No information was given concerning the number of subjects, their age or grade levels, or the method of selection. He concluded that the eye preferred in monocular tests was not always preferred in binocular situations. In addition, he expressed the opinion that muscular defects and visual acuity difference might influence reading efficiency, or choice of preferred eye. He recommended that cases of marked eye preference as indicated by his binocular reading test, should be subjected to visual tests.

It is clear from the foregoing reports that many questions relating to monocular and binocular reading are still unanswered.

Purpose of the study. This research was designed to answer the following questions:

1. Do unselected pupils in the middle grades read significantly better monocularly or binocularly?
2. Can standards be set for the Gray Oral Reading Check Tests to determine when the scores are significant?
3. Is the performance on the Gray Check Test read with each eye and both eyes related to scores on visual efficiency tests, monocular eye-preference tests, or the Binocular Reading Test?
4. Are there relationships between performance on visual efficiency tests, monocular eye preference, and results of the Binocular Reading Test?

To answer these questions it was necessary to select tests to cover the areas mentioned previously.

---

4. Lawrence Gahagan, "Visual Dominance-Acuity Relationships," *Journal of General Psychology*, IX (July, 1933), p. 455-59.
5. George Spache, "Eye Preference, Visual Acuity, and Reading Ability," *Elementary School Journal*, XLIII (May, 1943), p. 539-43.
6. George Spache, "A Binocular Reading Test," *Journal of Applied Psychology*, XXVII (1943), p. 109-113.

Selection of tests. To determine monocular preference, a battery of five tests was used. They were: the Parsons Manoptoscope; the sighting tube; sighting pictures through a hole in a cardboard; sighting over a pencil; and looking steadily at the examiner's nose between the subject's index fingers as they were brought closer together until one eye was covered. For each test, the pupil was required to use both hands so that preferred hand would not influence the chosen eye.

Two tests were used to compare monocular and binocular reading efficiency. The first was the Binocular Reading Test, described earlier, which was considered an eye-preference test by Spache, but permits monocular or binocular reading. The second was the Gray Oral Reading Check Tests, read with each eye alone, and with both eyes. Prior to this experiment, the five forms had been given to unselected school children and three comparable forms were identified for this study. The text was printed on transparent paper and placed in an instrument designed for this study. It was lighted from behind, and covered by a polaroid disc which the examiner could turn so as to occlude either eye without the pupil being aware of the change. The Binocular Reading Test and Gray Check Tests were used to determine monocular and binocular reading.

The Ortho-Rater[7] Visual Efficiency Tests, with two new slides made especially for children, were given to determine visual acuity and also to identify any other visual problems for which the test is designed.

Selection of pupils. The subjects were 75 pupils in grades IV, V, and VI of the Laboratory Schools at the University of Chicago. All pupils in one room of each grade were tested. These pupils were intellectually and culturally above average, and their level of reading achievement was beyond that usually expected. However, the range of reading scores was sufficiently wide to permit analysis of the results. Each pupil was tested alone in a quiet room, and the order of giving the tests was rotated to eliminate practice effect. All data were recorded on mimeographed forms.

FINDINGS OF THE STUDY

Monocular vs. binocular reading. Two forms of the Gray Oral Reading Check Tests were read monocularly and a third form was read with both eyes, in order that the time for reading and the number of errors made might be compared. The results are summarized in Table I below. The entries in this table show that a greater number of the pupils read more rapidly and more accurately with both eyes than with

7. By Bausch and Lomb Optical Co., Rochester, New York.

their left eyes, while other differences were not consistent. However, the critical ratios[8] of the means of the differences among right, left and binocular reading were insignificant at the 5 per cent level, regardless of whether time or number of errors was considered. Therefore, it seems quite probable that there are no significant differences in oral reading efficiency when middle grade pupils use their right eyes, left eyes, or both eyes.

TABLE 1
MONOCULAR VS. BINOCULAR READING

	Time	Errors
	Right vs. Left	Right vs. Left
Right Superior	30	35
Same	6	11
Left Superior	39	29
	Right vs. Both	Right vs. Both
Right Superior	32	31
Same	11	12
Both Superior	32	32
	Left vs. Both	Left vs. Both
Left Superior	28	24
Same	9	15
Both Superior	38	36

When individual pupils are considered, there is a difference in monocular and binocular performance of selected cases. As a means of identifying the cases where the difference in monocular and binocular reading is significant, the standard error of the difference of the mean was used. It is assumed that this standard error remains constant. Therefore, the differences in scores shown in Table 2 give a critical ratio of 2.58 and are significant at the 1 per cent level.[9]

TABLE 2
SIGNIFICANT DIFFERENCES IN MONOCULAR AND BINOCULAR READING SCORES

	Time in Seconds	Errors
Right and Left	20.97	6.29
Right and Both	19.15	7.57
Left and Both	17.45	7.10

The entries, in Table 2, show that a pupil must show a fairly large difference in time for reading with each eye and both, as well as the number of errors, if the scores are to be considered significant. Small differences, such as 5 or 10 seconds probably occur by chance,

8. E. F. Lindquist, *A First Course in Statistics* (Rev. Ed.), Cambridge, Mass.: The Riverside Press, 1942, p. 134-36.
9. Lindquist, op. cit.

hence should not be used as evidence of binocular inequality in optometric or educational practice, as has been done in the past. Likewise, a minimum difference of eight errors should be used to identify true differences in monocular-binocular performance, unless extended studies provide different scores. Among the 75 cases studied, only seven were identified whose scores were significantly different on the Gray Check Tests, according to the standards set in the previous section. The scores of these pupils on related tests are presented in Table 3. The first three cases showed significant differences in time for reading and one also showed significant differences in number of errors. The last four cases exhibited significant differences in number of errors only.

TABLE 3
TEST PERFORMANCE OF PUPILS WITH MONOCULAR - BINOCULAR DIFFERENCES

	Gray Check Tests Time			*Gray Check Tests Errors*			*Binocular Reading Test*		*Preference Tests*		*Visual Screening Tests Failed*
	R	L	B	R	L	B	R	L	R	L	
1	50	73	50	0	4	0	100%	5%	100%		Lateral and vertical phoria, distance and Near Depth, visual acuity L. near (unoccluded)
2	127	115	102	13	21	11	100%	100%	100%		None
3	87	66	63	3	6	4	95%	85%		100%	None
4	81	85	89	8	16	12	95%	90%	100%		Depth, Lateral Phoria Near.
5	102	102	103	18	18	9	95%	90%	100%		None
6	118	105	107	12	6	4	0	100%		100%	Lateral Phoria, Visual Acuity Right Far Depth
7	97	91	88	11	10	2	100%	100%	100%		None

Examination of the other tests reveals no consistent relationships for these seven children. Five of the cases preferred their right, and two their left eyes on the monocular preference tests. Two cases showed marked differences in scores on the Spache Binocular Reading Test, while five cases exhibited great similarity.

Considering only the cases who read more quickly or with fewer errors with both eyes, cases 2, 3, 5, and 7 passed all of the visual screening tests, while case 6 failed several visual tests, yet read with fewer errors when he used both eyes. Cases 1 and 4 read more efficiently with their right eyes, and failed several of the visual screening tests. The number of cases is too small to reach any conclusions, but those

TABLE 4

SCORES ON ALL TESTS

	Ortho-Rater Tests											
	Vertical Phoria	Lateral Phoria	Visual Acuity—Both	Visual Acuity—Right	Visual Acuity—Left	Depth	Color	Visual Acuity—Both	Visual Acuity—Right	Visual Acuity—Left	Vertical Phoria	Lateral Phoria
Case No.					Far					Near		
1												x
2												x
3												x
4					x*							
5												x
6												x
7												x
8												x
9				x								
10												x
11							x					
12					x*							
13												x
14						x						
15	x	x										
16		x										x
17				x			x					
18		x			*					*		
19						x						x
20		x				x						
21				x		x						
22			x	x		x						
23					x*	x				x*		
24	x	x									x	
25			x	x		x						
26		x		x*		x						x
27	x	x			x*	x						x
28		x		x*		x			x*			x
29			x	x	x	x						x
30	x	x				x				x*	x	x
31	x	x		x*		x					x	x
32	x	x		x*		x				x*	x	x

*Improved in acuity when the other eye was occluded.

TABLE 4 (continued)

No. of Visual Tests Failed	Binocular Reading Test			Gray Check Tests						
	% of Words Read with Right Eye	% of Words Read with Left Eye	% of Preference on Five Tests	Right Eye—Time	Left Eye—Time	Both Eyes—Time	Right Eye—Errors	Left Eye—Errors	Both Eyes—Errors	
1	100	100	R-100	94	79	80	4	4	9	
1	100	100	R- 80	61	65	64	3	3	5	
1	100	100	R-100	54	55	53	2	4	3	
1	100	95	R- 80	55	60	66	0	1	4	
1	100	100	R-100	76	72	70	10	7	9	
1	100	100	R-100	127	115	102	13	21	11	xx
1	100	100	R-100	55	50	52	0	1	0	
1	100	100	L-100	75	76	69	8	3	5	
1	100	100	R-100	46	42	46	5	1	2	
1	100	100	R-100	62	50	75	7	5	9	x
1	100	100	R-100	52	45	51	3	2	4	
1	100	90	R-100	46	50	50	1	3	4	
1	100	90	L- 80	61	58	62	3	4	4	
1	100	100	L-100	55	46	54	0	1	0	
2	100	100	L- 80	52	58	55	2	3	3	
2	100	100	R-100	43	55	57	1	4	5	
2	100	100	L-100	43	43	43	0	1	0	
2	100	30	R-100	49	41	43	5	1	1	
2	95	90	R-100	81	85	89	8	16	12	x
2	100	80	R- 80	67	50	51	5	1	4	
2	90	95	L- 60	59	59	64	6	8	7	
3	100	100	L- 80	55	51	58	1	2	1	
3	100	95	R-100	55	72	55	3	3	3	
3	100	0	R-100	62	81	76	4	9	9	
3	90	100	L- 60	54	51	55	1	3	2	
4	0	100	L-100	118	105	107	12	6	4	x
5	95	60	R- 80	50	46	50	1	1	1	
5	20	100	L-100	60	47	59	2	0	0	
5	20	100	L-100	55	44	54	1	1	1	
6	100	5	R-100	50	73	50	0	4	0	x
6	35	100	L-100	51	48	48	3	0	1	
7	75	95	L- 80	48	54	54	3	1	0	

pupils who read significantly better with both eyes tend to pass visual screening tests.

Analysis of cases failing visual screening tests. A second means of determining the value of the Gray Oral Reading Check Tests in identifying visual problems of school children is to select all pupils failing visual screening tests and determine their performance on the Check Tests. The results obtained on the ortho-rater were compared with those obtained on a previous study of school children.[10] The scores reported as passing on these tests were within 1.28 sigmas of the means. These standards are only tentative, but provide a means for selecting those pupils with serious deviations.

On the basis of this division, 32 of the 75 pupils failed one or more of the tests. Table 4 shows the tests failed for each pupil, as well as the scores on the Binocular Reading Test, the per cent of the eye preference based on five monocular preference tests, and the scores on the Gray Check Tests. Analysis of these entries are made to indicate interrelationships.

Four pupils failed the tests of vertical phoria at both far and near distance. Of these, only one read significantly better monocularly on the Check Tests, while all showed significant differences in performance on the Binocular Reading Test.

Among the eight pupils who failed the tests of lateral phoria at both far and near distance, the differences in monocular and binocular reading on the Check Tests were significant in only two cases and insignificant in six cases. However, the results on the Binocular Reading Test showed a marked difference in all except one.

Fourteen pupils failed the depth test, but of these, only three showed significant differences on the Check Tests. However, there was a difference of 20 per cent or more in scores on the Binocular Reading Test for 9 of the 14. There were 9 pupils who failed the depth test and in addition one of the tests of vertical or lateral phoria. Their scores on the Binocular Reading Test varied by 20 per cent or more, with one exception. It appears then, that the Binocular Reading Test scores are closely related to inadequate binocular functioning on the visual screening test, while the Oral Reading Check Tests show no consistent relationships.

Of the 10 pupils who failed the visual acuity test with their right eyes at far distance, four improved in acuity when their left eyes were occluded. In each instance there was considerable difference in per-

10. Unpublished study of 599 school children from grades III through VIII.

formance of the two eyes on the Binocular Reading Test, favoring the left eyes. However, the Check Tests failed to show such a difference. The results were proportional when left eye acuity at far distance was considered. There were so few failures in visual acuity at near distance that the results are not analyzed in detail.

It is assumed that if visual acuity in one eye is improved when the other eye is occluded, the condition is called suppression. Nine of these pupils suppressed either their right or left eyes at far distance, as shown by the asterisk in Table 4. Each of these pupils obtained unequal scores on the Binocular Reading Test. Furthermore, the non-preferred eye, according to the five monocular preference tests, was always suppressed. However, the results obtained from the Check Tests were far less conclusive. In only one case was there a significant difference in scores. In five of the eight cases, the suppressed eye read less efficiently, but the differences were slight. In three cases, the suppressed eye read more efficiently.

Summary of conclusions. The previous pages presented in detail the data upon which the following conclusions are based:

1. A group of 75 middle-grade children read equally well on the Gray Oral Reading Check Tests with their right eyes, their left eyes, and both eyes. Seven of the cases showed significant differences. The results of the visual screening tests given these children show no consistent patterns. There was a tendency for those pupils who read most efficiently with both eyes to pass all of the visual screening tests. The number of cases is too small to state that the Gray Oral Reading Check Tests are unrelated to visual performance, but the results point to the necessity for using extreme caution in interpretation of relationship until this study is extended to include a larger number of cases.

2. Tentative standards were established to determine when differences in time and errors for monocular and binocular reading of the Gray Oral Reading Check Tests are significant. It appears that 20 seconds and eight errors constitutes a difference beyond that of chance alone. The findings should be checked on another group to be more certain of these figures. However, until further data are secured, these provide some tentative standards for clinical examiners.

3. Performance on the Gray Oral Reading Tests given monocularly and binocularly does not appear to be related to failures on the orthorater tests of visual efficiency. The results raise a question concerning the value of these tests, given as they were in the present study.

4. There was a close relationship between scores on the Binocular Reading Test and failures on the Visual Efficiency Tests. The findings

show that the Binocular Reading Test indicates suppression of vision in one eye or the other when both are reading. Furthermore, the preferred eye is not the one suppressed. Therefore, the Binocular Reading Test appears to be valuable as a supplement to a visual screening test.

These four conclusions provide tentative answers to the questions posed at the beginning of this paper, and furthermore, show a technique by which such tests may be evaluated.

BOOK NOTICE

ENCYCLOPEDIA OF THE EYE. DIAGNOSIS AND TREATMENT. Conrad Berens and Edward Siegel. J, B. Lippincott Co., Philadelphia, 272 pp., 76 ills., 42 in color, 1950, $5.00.

This text was prepared as a part of the program of The Ophthalmological Foundation for those who wish a ready reference to the diagnosis and treatment of the more common ocular problems. It is believed that physicians, medical students, nurses and social workers, as well as ophthalmologists and/or optometrists, will find it of considerable value. The encyclopedic form affords a most convenient source of reference.

Brief descriptions of and the usual treatment for a great many of the more common eye ailments characterize the book. Included are more extensive sections on pediatric ophthalmology; strabismus; reading disability; and therapeutics. In the latter section there is listed the majority of drugs used in ophthalmology, their indication and dosage.

This practical, inexpensive, concise book by competent authorities on eye problems frequently encountered in routine practice should be welcomed by ophthalmic practitioners, students, and all those who have a need for reliable up-to-date information on ocular matters.

ROBERT E. BANNON

AN INVESTIGATION OF VOLUNTARY AS DISTINGUISHED FROM REFLEX ACCOMMODATION*

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What is *voluntary* accommodation? Webster's New International Unabridged Dictionary, second edition, gives one definition for *voluntary* as "Of or pertaining to the will; subject to, or regulated by, the will; as, the *voluntary* motions or muscles." The connotation is that the act is done consciously.

When one ordinarily accommodates in response to the optical stimulus and apparent distance of a blurred image, there may be a desire to see the object clearly but generally there is no conscious effort. This is termed *reflex* accommodation since it appears to be a direct non-volitional response to a blur stimulus and apparent distance just as the quadriceps respond to a sudden stretch of the patellar tendon in the well known simple knee jerk reflex.

Accommodation may be termed voluntary if a successful voluntary effort is made to change accommodation from that of the usual foveal reflex accommodation for the optical stimulus and apparent distance. Voluntary accommodation may be divided into two types, positive and negative. Positive voluntary accommodation can be defined as a greater accommodation than that which would ordinarily or reflexly be found for a given optical and apparent distance. Negative voluntary accommodation can be defined as that accommodation which is less than that found reflexly in a given individual.

For example, if a letter chart is placed 33 cm. before a subject, the optical stimulus to accommodation is 3.00 D. Let it be assumed that the apparent (psychic) distance is such that it does not conflict with this optical stimulus. The actual accommodation, i. e., the accommodative response to this chart, is measured and found to be 2.50 D. in this subject for this particular stimulus situation. The 2.50 D. is his normal reflex accommodation. If the subject now makes a successful effort to accommodate for a point nearer to himself than the fixated chart, for example 6.00 D., he is said to exhibit positive voluntary

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accommodation. Similarly negative voluntary accommodation is said to be demonstrated if the subject can wilfully relax his accommodation so that the point conjugate to his fovea moves more distant than the point found in ordinary reflex accommodation for the particular stimulus-subject situation. As an example it may be said that the accommodative response is 1.00 D. which is a voluntary inhibition of 1.50 D. from the original reflex accommodation of 2.50 D.

There is no simple way to assess what part of accommodation remains reflex accommodation while voluntary accommodation is active. The reflex stimulus must change with the increased blur concomitant with voluntary accommodation. For simplicity in terminology, however, the *total* accommodation in force when a successful effort is made to change accommodation will be called voluntary accommodation.

Judging from the literature, there has been little study of voluntary accommodation. Even the few investigations we find have not determined the actual accommodation of the eye but only stimulus values. It was therefore deemed worthwhile to review the literature and make a quantitative investigation of voluntary accommodation.

HISTORY

Psychologists have been interested in voluntary accommodation as a cue to the role of accommodation in the perception of visual space. Carr and Allen (1906) reported both positive and negative voluntary accommodation in one subject (Allen). A screen was placed at 290 cm. from the subject and a pair of vertical parallel wires whose separation from each other was adjustable was put a few inches in front of her eyes. The images of the wires were kept fused to show a constant convergence while accommodation was varied voluntarily. Changes in voluntary accommodation were reported associated with concomitant changes in apparent distance. When objects seemed nearer, positive voluntary accommodation was shown by pupillary constriction and by the higher dioptric indications of a phakoscope. Conversely, when pupillary dilation and lower dioptric indications were evident, objects receded in space. The conclusion was that depth is a function of accommodation for this subject. Voluntary accommodation could not be elicited definitely in other subjects (Carr, 1907, 1908).

Sisson (1937) described a subject with voluntary control of accommodation similar to the one of Carr and Allen. She differed from Allen in that she could exhibit positive but not negative voluntary accommodation. She also reported that accommodation played no essential part in her depth perception.

Not satisfied with a single subject, Sisson (1938) decided to

achieve voluntary control of accommodation himself. To this end he constructed a pair of sighting tubes with sights at both the far ends, about 23 inches away, and near the center, about 13 inches from the eyes. The tubes were converged for fixation at a point 75 inches distant. While maintaining this fixation, Sisson attempted to accommodate for the two pair of nearer sights. Success came quickly to him. By getting the "feel" of the act, he was soon able to elicit voluntary accommodation without the binocular tubes.

Sisson reported that with the greatest effort, he could see sharply at 6 to 8 inches (6.6 to 4.9 D.) with a fixation object at 10 feet, with diplopia. No spatial changes were evident with changes of accommodation.

The refractionist also is interested in voluntary accommodation for its clinical manifestations rather than for its possible significance in depth perception. Zentmayer (1935) reported on two hyperopic patients who had continuous spasms of accommodation. One might also describe this as latent hyperopia.

In one case the spasm was probably between 4.25 and 5.50 D. of accommodation and no asthenopia was reported. This patient was able to read clearly only by straining with great effort to see clearly. Apparently this was a negative voluntary accommodation. There is a difference between the mode of this voluntary accommodation and the experimental method discussed in the introduction and in the sections below. Zentmayer's patient voluntarily relaxed accommodation and made the optical stimulus clearer. He had the aid of reflex accommodation rather than, as in the experimental approach used here, having reflex and voluntary accommodations in opposition. It is not known if or how reinforcement and antagonism of reflex and voluntary accomodations differ.

It is now apparent that the literature on voluntary accommodation is very brief. No effort has been made to graph the actual response of accommodation when voluntary and optical stimuli were in conflict. This paper was undertaken to help fill this void.

APPARATUS AND PROCEDURE

The left eye was occluded and remained so throughout the experiment. The usual correction lens of the subject was placed before his right eye. A half-reflecting mirror at a 45° angle to the fixating eye reflected the point source of a stigmatoscope. The subject manipulated this instrument which yielded the accommodative response of his eye to the various stimuli presented.

Fixation targets were used at distances of 5, 1, ½, ⅓, ¼ and 1/5 meters. This allowed optical and proximal stimuli to accommodation of 0.20, 1.00, 2.00, 3.00, 4.00, and 5.00 D. The targets were two parallel black bars on a white ground photographically reproduced to present a space between them of about one minute of arc measured from the eye. Targets were presented in order; in some experimental runs from far to near and in others from near to far.

Seven subjects were chosen from the students and faculty of the school of optometry of the University of California. They ranged in age from 20 to 39 years with all the subjects but one between 20 and 29. Subjects were chosen for their professed ability to change voluntarily their accommodation either positively or negatively and thus blur the object of regard.

First each subject was told to regard with attention each of the six targets presented to him as he normally looks at any object of interest. For each target, five measurements were made with the stigmatoscope which were later averaged to show the accommodative response from the stimulus mentioned. This response is reflex accommodation.

Then each subject was instructed to attempt to accommodate for a point beyond the target, viz, negatively, while fixating the parallel bar target at each fixation distance. The same type of measurements were made by stigmatoscopy for the accommodative response.

The same procedure was followed for attempted accommodation for a point nearer than the target, viz, positively, while constantly fixating the target.

Subjects were instructed to fixate the target and not the point-source image of the stigmatoscope. Hence, this image should not have provided any appreciable stimulus to accommodation.

RESULTS

All the results are graphed in Figures 1 and 2. All subjects exhibit normal reflex accommodation as originally demonstrated by Ames & Gliddon (1928) and also, monocularly, by Morgan (1944). Characteristically they show up to 1.25 D. of "myopia" when measured by a stigmatoscope with fixation at 5 meters. The theory behind this apparent discrepancy, which is fundamental in accommodation, has been discussed elsewhere (Morgan, 1944).* Most of the subjects,

*Emmetropia as measured clinically has what might be called a "plus lens bias." This is an obvious consequence of the general clinical procedure in refraction of the selection of maximum convex or minimum concave lens for maximum visual acuity. It is believed that the eye may utilize its depth of focus when part of it is anterior to

however, show less than 0.50 D. of this added refractive power of the eye by stigmatoscopy with 5 meter fixation.

Accommodative response generally remains no more than 0.75 D. behind the stimulus as represented on the graph by the unit ratio line.† In one subject there is about a 1.50 D. lag of accommodation behind the 5.00 D. stimulus.

Six of the seven subjects could exhibit large amounts of negative voluntary accommodation whereas the seventh subject (K.G.) exhibited it to a small but obviously significant degree. This subject appears to demonstrate that while a voluntary effort to inhibit accommodation may show some minor success, the optical and proximal stimuli are relatively more dominant in this subject. It seems likely that with the proper training the optical and proximal stimuli could be subordinated to the effort of the will to relax accommodation.

Another interesting phenomenon seems evident. It is an apparent increase of negative voluntary accommodation as the optical stimulus is increased. This means that some individuals appear to be able to relax more accommodation voluntarily when the optical and proximal stimuli to positive accommodation are increased. This seeming paradox is best illustrated in the graph of G. D. where the negative voluntary accommodation is more than 0.25 D. greater with 5.00 D. fixation than with 0.20 D. fixation. This apparent effect may not be statistically significant, and it will require more refined techniques to be reasonably certain of its existence.

The repeatability of reflex and negative voluntary accommodation is seen by a comparison of the graph of R. H. in Figure 1 and the same subject taken on another day, R. H. retake in Figure 2. The two pair of curves show the same general form and any difference between them is of questionable significance.

The subjects may be divided into three rather arbitrary groups on the basis of their positive voluntary accommodation: (1) Those who exhibited voluntary positive accommodation without being influenced by the optical and apparent distance stimuli. (2) Those who were so

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the receptive outer segments of the foveal cones. Hence, little or no change of shape of the crystalline lens may occur for the first half diopter or so of "accommodation."

†The term "unit ratio line" describes the diagonal on a graph (as illustrated in the figures above) showing the monocular function of equal units of accommodative stimulus and response. The same terms may be used for the diagonal on another graph showing the binocular function of equal units of accommodation in diopters and convergence in meter angles. This is what Donders called "the line of convergence" and subsequent investigators have called "Donders' line." Donders in his time was not aware of the stimulus-response graph of accommodation. It would seem better, therefore, to use "unit ratio" rather than Donders' name as has been done to describe the line in the type of graphs illustrated in this paper.

influenced. (3) Those who could not effect positive voluntary accommodation.

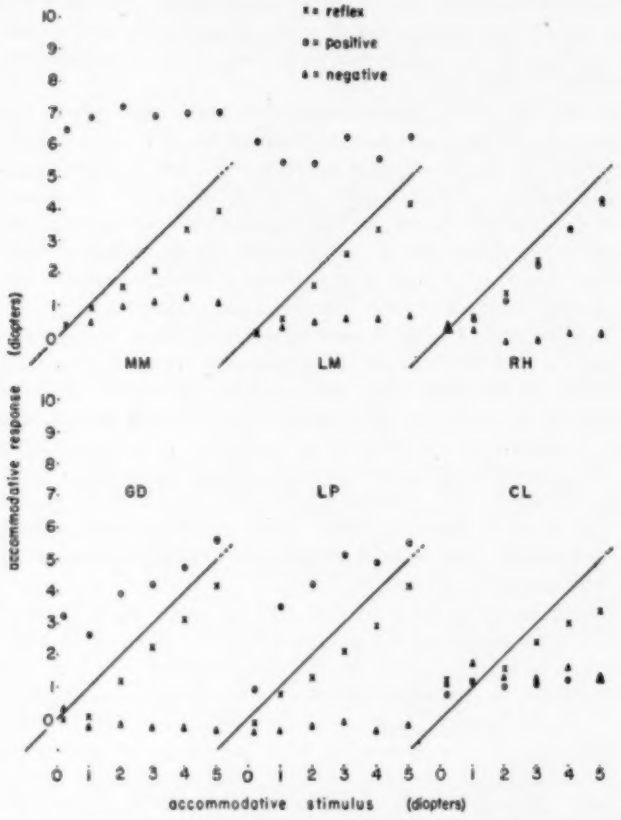

Fig. 1. The ordinates are accommodative response as determined by five readings of the stigmatoscope for each point. The abcissas are the optical stimuli. Voluntary stimulus cannot, of course, be measured. The voluntary response is evident by departure from the reflex response. The crosses signify ordinary reflex accommodation. Circles show *attempted* positive voluntary accommodation. Triangles stand for *attempted* negative voluntary accommodation. The diagonal line is the unit ratio line representing a 1:1 ratio between stimulus and response.

In Figures 1 and 2, subjects M. M., L. M., and K. G. show no effect of the target on their accommodative efforts. There is a fair degree of scatter in the points of the latter two subjects. This scatter

is to be expected since the degree of positive voluntary accommodation depends in part on the effort maintained which is in most subjects spasmodic and not smoothly sustained. It also depends on the practice one

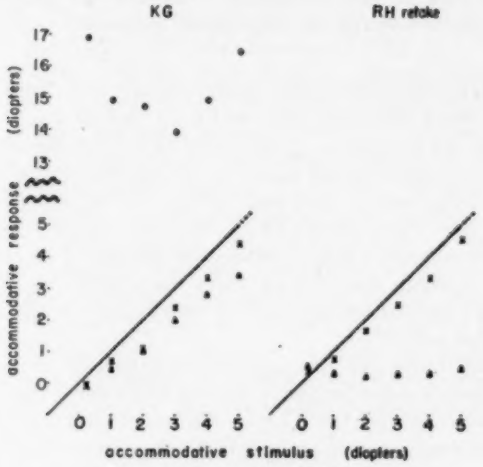

Fig. 2. See legend of Figure 1.

has had in controlling the normally "involuntary" eye functions. Practice reduces the effort involved. That is probably the reason that M. M. who has had many years of experience with free stereoscopy shows so little scatter. It is interesting to note that K. G. has an unusually large amplitude of voluntary accommodation averaging 15 D. This was about equal to his reflex amplitude.

Two subjects (L. P. and G. D.) gave an increase of voluntary positive accommodation with increased optical and apparent distant stimuli to accommodation. To put it in another way, their voluntary positive accommodation appeared to tend to be limited by the physical stimuli to accommodation.

Of the two remaining subjects, one (R. H.) showed no positive voluntary accommodation. In fact, if the difference in most of the points can be considered significant, there was slightly less accommodation with effort to increase it than under normal reflex conditions of stimulus. The other subject (C. L.) with a Herculean effort to increase his positive voluntary accommodation, actually manifested more negative voluntary accommodation than he had in previously attempting it. It would seem that the organism ordinarily cannot tell whether a blur is from

the image falling in front of the retina or tending to fall behind the retina. If there are any cues from the apparent distance, the state of accommodation or the character of the blur "circles" on the retina, they do not seem to help in making conscious this great discrepancy between the intentions and the response of the subject.

DISCUSSION

Voluntary accommodation, both positive and negative appears to be much more common than would be judged by its infrequent appearance in the literature. A cursory poll yielded the surprising information that nearly half of a class of 50 optometry students claimed that with a little practice they could elicit it to an appreciable degree. This would agree with Sisson (1938) who said, "The whole procedure [of voluntary accommodation] seems to be identical with that involved in learning to wiggle ones ears or move one's scalp, etc., i. e., getting the 'feel' of muscular adjustments involved, so that these can later be duplicated at will."

Carr and Allen and also Sisson were interested and succeeded in eliciting voluntary accommodation during single binocular vision with a constant total convergence. Their aim was to vary accommodation while maintaining convergence constant, thus separating accommodation and convergence. If total convergence is divided into the components proposed by Maddox and quantified by others since the investigation of Sisson, fixed total convergence appears to be an unnecessary limiting and perhaps complicating element which is better omitted. For these reasons it was felt that monocular observation was sufficient throughout the experiments reported here.

It is not at all likely that the stigmatoscope image acts as the stimulus of the large changes in voluntary accommodation. The heavy blurring, which occurred with attempts to change accommodation, occurred even with the stigmatoscope set for the target distance or even without any apparatus at all so that the stigma could not have acted as the primary stimulus for the phenomenon. However, it is entirely conceivable that the instrument may have had a minor effect in the results. The measuring instrument would be expected to have no effect as long as the subject fixates the parallel bar target and as long as the target remains clear enough to provide the optical and proximal stimuli to accommodation. Future investigators of small amounts of voluntary accommodation could avoid this possible criticism, however, by using an optometer that cannot stimulate any accommodation such as the slit or the coincidence optometer of Fry flashed on for very brief exposures.

It may be of interest to some to mention incidentally that none of the subjects experienced any change in their appraisal of spatial relationships in either positive or negative voluntary accommodation.

Various symptoms associated with attempted positive voluntary accommodation were reported such as "tension in abdomen" (R. H.), "burning in eyes" (C. L.), "eyes hurt a bit" (M. M.), "eyes do not hurt but there is a feeling of tension or pull on them" (L. M.). Reports of these common clinical asthenopic symptoms occurred when a voluntary effort was made to elicit positive accommodation. It did not occur in the demand for reflex accommodation or for attempted negative voluntary accommodation. Therefore, this lends support to the old clinical theory that symptoms arise from the *need* to exert effort to reinforce a reflex function that is inadequate. Training which facilitates the voluntary function might then relieve the symptoms. One must be cautious in any interpretation of the data given here since, as already mentioned, the voluntary effort was opposed to the reflex and not in harmony with it. And why two subjects (R. H. and C. L.) had symptoms with *attempted* positive voluntary accommodation which they could not achieve is an interesting unanswered question.

SUMMARY

Voluntary accommodation may be defined as accommodation which can be varied by conscious effort from the zero point of ordinary or reflex accommodation while the reflex (optical and apparent distance) stimuli remain unchanged. A division may be made into positive voluntary accommodation where there is accommodation for a point nearer than that found reflexly, and negative voluntary accommodation where there is accommodation for a point more distant than that ordinarily found.

Seven subjects who professed to have either positive or negative voluntary accommodation were measured and the results were graphed for their reflex and attempted voluntary accommodations. Reflex accommodation was normal. Six of the seven subjects exhibited large amounts of negative voluntary accommodation; one subject showed only a small degree of it. Five subjects exhibited positive voluntary accommodation in varying degrees. Of the other two subjects, one subject unknowingly elicited a large amount and the other subject a small amount of negative accommodation while attempting positive voluntary accommodation.

The possible clinical significance of the asthenopic symptoms associated with attempted positive voluntary accommodation is discussed.

The ability to control accommodation voluntarily is far more common than one would believe from the very few instances cited in the literature.*

*This paper was read before the San Francisco Bay chapter, American Academy of Optometry, Berkeley, California, May 24, 1951. The author is now on military leave to Aero Medical Laboratory, Wright Development Center, Wright-Patterson Air Force Base, Dayton, Ohio.

REFERENCES

Ames, Adelbert, Jr., and Gordon H. Gliddon (1928): Ocular Measurements. Trans. Sect. Ophthal. A.M.A. 1928, pp. 102-175.

Carr, Harvey and Jessie B. Allen (1906): A Study of Certain Relations of Accommodation and Convergence to the Judgment of the Third Dimension. Psychol. Rev., *13*, 258-275, 1906.

Carr, Harvey (1907): Apparent Control of the Position of the Visual Field. Psychol. Rev., *14*, 357-382, 1907.

———— (1908): Voluntary Control of the Distance Location of the Visual Field. Psychol. Rev., *15*, 139-148, 1908.

Morgan, Meredith W., Jr. (1944): Accommodation and Its Relationship to Convergence. Am. J. Optom. & Arch. Am. Acad. Optom., *21*, 183-195, 1944.

Sisson, E. Donald (1937): A Case of Voluntary Control of Accommodation. J. General Psychol., *17*, 170-174, 1937.

———— (1938): Voluntary Control of Accommodation. J. General Psychol., *18*, 195-198, 1938.

Zentmayer, William (1935): Voluntary Control of Accommodation. Am. J. Ophthal., *18*, 1134-1136, 1935.

BOOK NOTICE

ESSENTIALS OF OPHTHALMOLOGY. Roland I. Pritikin. J. P. Lippincott Co., Philadelphia, 561 pp., 215 ills., 18 in colors, 1950, $7.50.

This is an ambitious little book designed to give a fundamental yet comprehensive coverage of the whole field of clinical ophthalmology. The author has had wide experience in this field as a physician, surgeon, writer and teacher. The text is profusely illustrated by many excellent photographs, figures and diagrams.

The book begins with the principles of anatomy and physiology of the eye. It includes phases of examination, optics, operative treatment of muscular dysfunction, and the correction of ocular anomalies by means of spectacles. There is a chapter on industrial ophthalmology and a helpful study of first aid for eye injuries is also included as well as tables on ocular manifestations of general diseases.

The material presented is intended to provide a handbook of essential information on the eye and its diseases so the physician in general practice may use it in preparing for examinations on the eye.

ROBERT E. BANNON

ONE HUNDRED YEARS OF THE OPHTHALMOSCOPE— VON HELMHOLTZ, THE MAN, HIS LIFE AND WORK*

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December 17, 1950, might well be looked upon as the birthday of modern ophthalmology and optometry. On this memorable day, Helmholtz created the *Augenspiegel* (eye mirror) as he called it, and he was the first human to see the interior of the eye. It is therefore no more than fitting that we pay tribute to the 100th anniversary of this epoch-making event.

Many are the honors which have been bestowed upon Helmholtz, but because of his outstanding achievement in making the *Augenspiegel* and writing the classic, "The Handbook of Physiological Optics," we tend to overlook his other achievements in the whole field of physics, and their far-reaching results upon humanity. Helmholtz's knowledge was universal. He has to be classed among our greatest along with Leonardo da Vinci, Duerer, Michelangelo, Galileo, Newton, etc. To bring a deeper understanding about the man and his work is the reason for this paper.

Hermann Ludwig Ferdinand Helmholtz was born August 31, 1821, in Potsdam, the first child of August Ferdinand Julius Helmholtz and his wife Karoline, née Penne. The Helmholtz home was one of great learning and culture. The father was *Oberlehrer* in the Potsdam

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Gymnasium. He was an excellent teacher who loved the Greek classics and knew how to arouse enthusiasm in his pupils. He also taught Latin, German, mathematics and physics, and wrote a few scientific papers in the humane fields.

Helmholtz's life was developed in a religious atmosphere with Christianity the basis of his ethics. Religious and philosophical questions were always of interest in his home, and the father had great influence in shaping the thoughts of his children. He aroused in them a love for art, literature, music and patriotism. On his many walks with his eldest son, he awakened in him a love of the study of natural phenomena, which later were to become the life work of Helmholtz.

For the first seven years, Hermann was a sickly child. Reading came at an early age, but he did not have a good memory, and said of himself that he had difficulty in differentiating between left and right.

When he was seven, he entered public school at Potsdam. Although he was often absent through sickness, he surprised his teachers with his quick understanding, especially in geometry. Before he was nine, he entered the Gymnasium, where his father used his influence on his son more than ever. He completed the first three years in two. With the greatest zeal he read all books on physics in his father's library. He and a schoolmate made some of the experiments he read about, with many failures. He was best in the construction of optical instruments with the aid of old spectacle lenses and a small loupe. He had little money, and learned to use the lenses over and over again in his experiments. While his class read Cicero and Virgil, in whom he had no interest, he figured and traced under the table the rays through a telescope, and thereby discovered some optical laws he could not find in his books. These things came very handy later on in the making of his ophthalmoscope.

His father's friendship with other teachers and intellectuals permitted him to take part in many of their discussions. At that time, the thought came to him that it must be possible to solve further the secrets of nature and to overcome the limitations in knowledge of that time. Next to Greek and Latin he studied Hebrew, French, English and Arabic. He was 17 when he finished the Gymnasium, and his report card speaks of his high mentality, his true character and fine deportment. While still in the Secunda at 14, he knew that his inclination was for the natural sciences, and that he wanted to become a physicist, which at the time was looked upon as a field in which it was impossible to make a living. His parents were forced to a spartanic way of life, and Helmholtz could not get much help financially for studying. His father told

him he could only help him to study physics if he would study medicine first. This Helmholtz immediately accepted. His father went to the medical-surgical Friedrich Wilhelm Institute, and asked for his son's admittance. In this institute the cost of the studies was made very easy; the students needed only 6 *Talers* monthly from their parents, while tuition, room and board were free. For this the young doctor had to promise to serve in the Army as a military physician for eight years. Many tried to enter the institute, but only the best could pass the entrance examination. Helmholtz matriculated, and his father asked him to "remain true and dedicate himself with earnestness and love to his profession, science and virtue."

Like all young students, he had to endure all kinds of chicanery by the older comrades, which went against his nature. While they talked in banal ways or played the piano for dances and popular song hits, he had to leave the room, as he had only sense for the classical music, especially Mozart. He kept very much aloof, read Kant, Byron and Goethe, and in general, became known as a bad mixer.

His course of lectures amounted to 48 hours each week, and with his studies at home this did not leave him much time for recreation. He was very much interested in physiology, which was taught by Johannes Mueller, with whom he became very friendly. In this group of fellow students were Bruecke, du Bois-Reymond and Virchow, who became the father of cellular pathology. At this time he found that the answer to many problems came easier in discussion among friends. Helmholtz's mathematical knowledge helped him very much and while he worked at the library, he studied the writings of mathematicians Euler, Daniel Bernoulli, d'Alenbert and Lagrange.

In the medical-physiological field his first work was the examination and connection of the nerve fibers and the ganglia. The ganglia were thought to be in the higher animals, but this could not be documented. He demonstrated this on a few invertebrates, but when he showed it to his teacher, Johannes Mueller, he instructed him to enlarge the experiments on vertebrates.

The weak constitution of Helmholtz could not stand the strain of studies, and in July, 1841, he became ill from overwork and an infection. A nervous fever and typhus followed, but in spite of all this, in September, 1842, he entered the Charitey hospital in Berlin, where he worked in the internal division. On November 2, 1842, at 21 years of age, Helmholtz became Doctor of Medicine. His thesis was, "The Structure of the Nervous Systems of Invertebrates."

The findings in this research, that the nerve fibers come from the ganglion cells, represented microscopic anatomy in a work of the highest order, and it became a basis of a totally new physiology and pathology.

Through his great work he advanced rapidly, and with his job as assistant to the chief doctor of the regiment in Potsdam, he had more time to devote to scientific problems. After two years, he returned to the Friedrich Wilhelm Institute for a five-month postgraduate course to prepare for examination for the practice of medicine. At the same time he became a member of the New Association of Physics.

Helmholtz then went back to his old post at Potsdam, and there he worked on his law of preservation of energy. In a meeting before the Association of Physics, July 23, 1847, he demonstrated the connection between the various powers of energy of each substance, which may appear in various forms such as mechanical, electrical, magnetical, thermical or chemical energy, and that these energy forms can, under observation of certain numerical differences, be transformed one into another.

Many scientists were opposed to this law, especially men who leaned toward the philosophy of Hegel and Schelling and their metaphysical speculations. To this latter group belonged his father, and in talks with his son, he tried to bring him back to the old concept. Because of this, Helmholtz became rather silent towards his father, but when the father saw how right his son was, he wrote to him, saying he hoped the Lord would further make him the "prophet of truth."

In 1948 through his friend Bruecke, Helmholtz was made teacher of anatomy at the Academy of Arts in Berlin. His military services were cut short by three years as a reward for his outstanding accomplishments. One year later he was called as professor of physiology and pathology at the University of Koenigsberg to succeed his friend Bruecke. This job offered him security, and he married Olga von Velten. She was a woman of great charm and high intelligence who helped him very much in his work. At the University he made some experiments in the speed of transmission of nerve impulses. It was thought that no time interval existed between a stimulus and its transmission to the brain centers. Helmholtz measured this speed for the first time and found it to be small —between 30 and 50 meters per second. The experiment was made on frogs. Since he worked with rather short nerve fibers, and only small time intervals could be measured, the difficulties were very great. He found, in working on the question as to what kind of nerve excitation existed, and what changes were taking place along its path from the stimulus to the brain, that certain chemical changes in the nerve substance were occurring: that is, a different arrangement of the molecules.

In the same year Helmholtz created the *Augenspiegel*. Through a paper on general pathology and physiology he came to the question why the eyes of some animals, mainly cats and owls, seem to be self illuminating in the dark. As a thorough teacher, he wanted to give only one explanation, based on absolute scientific experiments. It was easy to show that the eyes shone only when rays of light entered them in otherwise dark surroundings. He assumed the retina to be of lighter color, especially in cats and owls, as they were able to return the entering light extremely well. To convince himself that this was so, a way had to be found to see into the eye, and to illuminate the retina artificially. The difficulty was that the eye had to look in the same direction in which the light entered, so Helmholtz constructed from spectacle lenses and microscopic slides, which he glued together, the first ophthalmoscope.

Figure 1, taken from the original text of Helmholtz, represents a schematic drawing of how Helmholtz attacked the problem. B is the

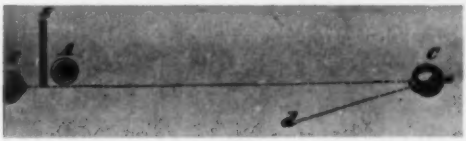

Fig. 1

eye of the observer, S a screen to protect the observer from the light A. C is the eye to be observed, and BC is the viewing line of the observer. Cd is the viewing line of the eye under observation. The observer will see the reflex of the observed eye as a red shine, and if the entering rays of light fall on the optic nerve head, a brighter illumination will be noticeable.

Figure 2, from the same source, shows a better arrangement. Helmholtz used a plano-parallel plate but pointed out that a mirror with a peephole would serve the same purpose. Although the observer saw the background of the eye illuminated, it was impossible for him to recognize anything, because he could not accommodate for the image created by the ocular media. To bring this about certain lenses had to be added.

Figure 3 represents the erection of a virtual, erect and enlarged image, and Figure 4 represents the image created as a real inverted one. Here a convex lens is needed.

The making of the ophthalmoloscope was rather difficult but within a week or so Helmholtz had mastered this and had the satisfac-

Fig. 2

tion of being the first individual to see the retina and the interior of the eye in general. He was very much impressed and knew the importance the instrument would play in the future, not only in ophthalmology but in medicine generally. Today, many improvements have been made

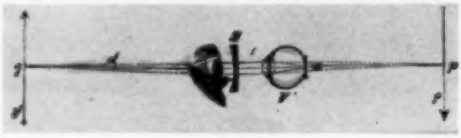

Fig. 3

on the appearance and performance of the *Augenspiegel* or ophthalmoloscope, but the theory and basic principles of the instrument are still the same as outlined by Helmholtz.

On December 17, 1850, Helmholtz wrote his father about the

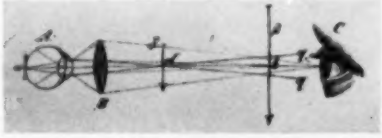

Fig. 4

creation of the *Augenspiegel*: "It was rather easy, and did not need any greater knowledge of mathematics than the one taught about optics at the Gymnasium. It is almost laughable that others and I could not come to this deduction any sooner. The instrument is a combination of lenses, whereby it is possible to illuminate the background of the eye through the pupil and view the retina in its minutest details, even bet-

ter, because the outer part of the eye is seen without any magnification. The transparent media assume the place of a loupe, and the retina is seen about 20 times enlarged. It is beautiful to see the arteries and veins and the entrance of the optic nerve, etc."

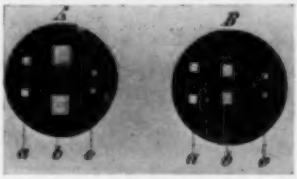

Fig. 5

As the German scientist continued his work he was more and more attracted by the problems of physiological optics. He examined the color mixtures of pigments and light, form and distances of the refracting medias in the eye, mainly the cornea and lens, and in connection with this the path of light rays in the eye. He was most attracted to the question of accommodation, and the solution was expedited through the construction of an ophthalmometer. At first he used crossbeams of a bright window as mires while the surface of the eye acted as a mirror. Later as mires he used two scales, one with a single light source, and the other with a double light source. By bringing them into alignment, he could read off his measurements. By this method he developed the constants of the radii of the cornea and the lens, and figured the indices of the various media.

Gullstrand says in his addition to the Helmholtz *Handbook for Physiological Optics*: "Since the construction of the first ophthalmometer by Helmholtz, time has brought great advancements and changes of ophthalmometry in measurements on the front surface of the cornea. The physiological examination method became a blessing in practical ophthalmology for all humanity. Every physician, and I may add optometrist, is using it but, if by today's effortless methods he thinks that the success is the result of the improved instruments, he is mistaken. The merits for the method are and remain the property of Helmholtz. To Javal and Schiötz belong the honor of advancing the instrument most, as well as its use."

Figure 6 is a schematic drawing by Helmholtz showing the difference of the eye, half while the accommodation is at rest, and the other half while it is in force. In an outline of his theory Helmholtz states that through contraction of the ciliary muscle, the choroid is pushed

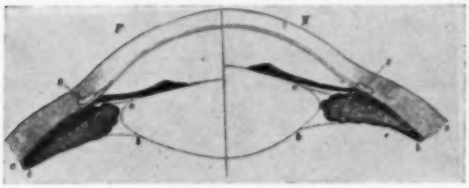

Fig. 6

forward, and that the relaxing zonules permit the lens through its own elasticity to assume a more spherical character. The equatorial diameter of the lens decreases, the equator recedes inward, and toward the axis of the eye, and is so kept from forming contact with the ciliary processes as they advance.

In Summer of 1853, Helmholtz visited England for the first time, where in the City of Hull he was to speak about his examination of the mixture of homogeneous colors. His fame by that time was established. He met Tyndell and Faraday, and later in Germany, Thomsen. With all whom he met, he remained great friends.

Helmholtz had his share of joy and sorrow during his stay in Koenigsberg. His wife gave birth to a daughter and a son, but she became ill, and it was obvious that she could not stand the cold climate. Since Helmholtz had been asked to be professor of anatomy and physiology at the University of Bonn, he accepted in March, 1853. With the warmer weather at Bonn, his wife's health improved. While at Bonn he continued to work on the physiology of the eye, and the first part of *Handbuch der Physiologischen Optik* was printed. He delved into the question of accoustics and the reason for harmony. In mathematics he solved some mysteries in the field of hydro- and aerodynamics.

After 18 months at Bonn, Helmholtz received a call to be professor of physiology at Heidelberg, but it was a year later before this materialized. Here he met Kirchhoff and Bunsen, and with them he led the University of Heidelberg to a period of great glory. Again he studied the problems of physiological optics and also the accoustics. Through Fechner's observation and law of the contrast differences he was led to his color theory that the eye is sensitive to three basic colors. He examined the physiology of vision closely. One of his most important discoveries was the function of the rods and cones of the retina. He postulated the macula as the point of most acute vision. He found

the greatest sensitivity of the eye to be in the green light and a wave length of about 0.00055 mm., and light of a wave length above 0.0008 mm. and below 0.0004 mm. invisible to the eye. He used as a comparison the field of accoustics, previously used along the same lines by Newton. The measurements were so excellent that more than 40 years passed before more exact data could be found.

Working with such enthusiasm on these questions it was only natural that Helmholtz would develop his color theory. After many trials he came to the conclusion that the eye is sensitive to the three primary colors, red, green and violet, and that according to the relative strength of the excitation a specific color impression is obtained.

Through his studies of the after images, Helmholtz came to the conclusion that if an eye is exposed for a period of time to one color, it becomes fatigued and is less and less sensitive to this color. In his measurements of the after images he showed that fatigue begins after exposure of 1½ seconds.

The color theory and all its complications gave Helmholtz many hours of hard work. He was therefore very much surprised to find that about 50 years before him Thomas Young thought along similar lines. Young was then of the opinion that the optic nerve has three different nerve fibers, each of which is sensitized by its own color—red, green and blue. Helmholtz on the other hand, thought that in every fiber the three functions could be present independently. According to his theory every spectral light source sensitizes at least two and mostly all three components in different strengths. In view of Young's contribution, the color theory became known as the Young-Helmholtz theory.

In comparison to optical instruments, the eye has many faults. To mention only a few are chromatism, astigmatism, clarity of the lenses, the blind spot, etc. While speaking of them, Helmholtz said, that if an optician would sell him an instrument with all these faults, he would turn it back with sharpest protests and condemn him for the negligence of his work; but he added, that the construction of the eye, while it is not an absolute, is still a practical solution.

In the field of accoustics Helmholtz did the same outstanding work as in optics. Every theoretical question which arose, he undertook to answer through experimentation.

While Helmholtz was climbing to still greater heights and successes his father died and his wife again became very ill. His own health had also been failing. On December 29, 1859, his wife died. Following her death he showed no interest in anything and suffered

oftener from fainting spells. But to overcome his grief he returned to Heidelberg and worked harder than ever. Later, he married again.

Helmholtz lectured in England, France and Spain. Whenever he was the victim of prolonged migraine attacks, he interrupted his routine and went to Pontresina. There he studied the effects of the Alps on the winds coming from the South, and in general was led into the field of meteorology. His contributions to scientific knowledge of the weather are considered as great as those in other fields.

Many were the honors Helmholtz received. It is interesting to know that the first ones came from foreign countries. Many titles, medals and honorary doctorates were conferred upon him. Hard and fruitful work brought Helmholtz more and more into the field of pure physics. In the Spring of 1870, Professor Mayners, who taught physics at the University of Berlin, died, and Helmholtz was called to be his successor. His friend, du Bois-Reymond, was president of the University, and he had much to do with bringing Helmholtz to the faculty. Du Bois-Reymond pointed out that with this call, the never-heard-of had come to pass—an M. D. and professor of physiology would occupy the chair for physics.

In Berlin his attention was first in the field of electro-dynamics and also in aero-dynamics. It is interesting to note how wrong Helmholtz was in the latter, as we understand it today. He came to the conclusion that the size of birds who have the ability to lift themselves and who can stay in the air for a long time, must be limited. Helmholtz also thought that nature had found its limit in the largest vulture and that man would never be able to lift himself from the earth by any kind of wing mechanism and cover any distance.

He was very thorough in everything he undertook. A perfect example is the examination of the microscope. He was not satisfied until he found the limits of magnification of the instrument. He examined the influence of light intensity used, and the spherical and chromatic aberration of the instrument, and came to the conclusion that under otherwise excellent conditions, the limit for the visible size differentiation was equal to half of the wave length of the used source of light.

His leadership and meteoric rise in the field of science made him many friends and enemies. The latter attacked him and his family whenever possible. This was mainly due to the strong denunciation Helmholtz used to combat some metaphysical views. Still, it helped to undermine his health.

The faculty made him president of the University of Berlin in

1876, and with great ceremony in 1882 the Kaiser declared him to be of nobility and from then on he was von Helmholtz. In 1886 he was the first to receive the Golden Medal in honor of the ophthalmologist von Graefe. Then *Pour le Merite*, Germany's highest order followed, and he was elected to be vice chancellor of that order. At that time the painter Adolpf Menzel was chancellor of the order, and when Helmholtz asked him what his duties were, Menzel replied, "Wait until I am dead to become chancellor."

Migraine attacks and fainting spells now occurred oftener, and with his failing health, Helmholtz decided to restrict his teaching activities to a selected few who were able to follow his thoughts.

With the help of Werner von Siemens and the German State, the *Physikalische Technische Reichsanstalt* was founded. It was the duty of this institute to bring order and unity into all fields of physical science, and to norm the weights and measures and energies. This proved to be of such importance that other countries including the United States, followed this leadership, and created similar institutions. When the *Anstalt* opened, von Helmholtz was made president, and more honors came to him. He was almost 70 years old when he was asked to sit for a marble bust, and when it was unveiled, the whole world paid honor and tribute to him.

But aging brought its sorrows. His elder son, Robert, who followed his footsteps and was a scientist in his own right, died at an early age. His other son was ill, and mentally retarded, which contributed to von Helmholtz's anxieties. Werner von Siemens and his star pupil, the great Henrich Hertz, died, as did many more with whom he had worked closely. Von Helmholtz became tired and needed rest.

In 1893, he received an invitation to come to the World's Fair in Chicago. He did not want to accept, and one reason he gave was that he felt nothing of scientific value would come from such a gathering. On the other hand, he was very much fascinated with the prospect of getting acquainted with America. Strangely enough he prophesied in a letter to his friend, Knapp, who lived here: "I know very well that the land America will be the only real and true future of humanity and its civilization and that it includes a great many people and intellects, while we in Europe see chaos or the Russian world domination come closer and closer." That was written 57 years ago!

After great pressure on the part of the Kaiser and the German government, von Helmholtz accepted the invitation in order to look after the interests of the German Reich at the electrical Congress. During his stay in the United States, he visited the Rocky Mountains (including

Pike's Peak), Niagara Falls, Boston and Harvard University.

After his return to Germany, on the evening of October 12, 1893, von Helmholtz suffered one of his fainting spells and fell head first down a narrow staircase, and was seriously injured. On July 12, 1894, he was paralyzed by a stroke, and more of them followed, resulting in his death on September 8, 1894.

At the memorial service for von Helmholtz, the Kaiser suggested the erection of a monument to him, and donated a great amount of money for this purpose. This statue stands on the campus of the University of Berlin, a symbol for his followers to work and strive for a better understanding among all mankind. The most enduring edifices, however, are his teachings and writings. They will remain classics in the field of science, in spite of its rapid advancement today.

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REFERENCES

Helmholtz, Hermann von. Handbuch der Physiologichen Optik. Dritte Auflage mit Ergaenzungen von Professoren Gullstrand, von Kries und Nagel.

Ebert, Hermann. Hermann von Helmholtz. Wissenschaftliche Verlagsgesellschaft Stuttgart.

Planck, Max. Vortraege und Erinnerungen, Fuenfte Auflage Wege zur physikalischen Erkenntnis.

Adler, Francis Heed. Clinical Physiology of the Eye.

ABSTRACTS

FURTHER STUDIES IN THE RELATIONSHIP BETWEEN HETEROPHORIA & PRISM VERGENCE. R. G. Scobee and E. L. Green. Am. J. Ophth., 34(3), 401-404, March, 1951.

Although the authors' previous study (Am. J. Ophth., 31: 427, 1948) indicated that the correlation between lateral heterophoria and prism divergence at far was significant, the small statistical relationship made them perplexed since their clinical experience and that of others suggested a much stronger relationship. Therefore, they restudied their data and the *apparent* prism vergences were converted into *true* vergence measurements by using the heterophoria readings at the same testing distances. Correlation coefficients were then determined using the figures for *true* vergences.

There was no statistically significant relationship between age, spherical equivalent of the refractive error, sex, and the heterophoria. However, there was significant relationship between *true* prism divergence and lateral heterophoria. This relationship was very much greater when the *true* prism divergence was substituted for the *apparent* prism divergence.

R. E. B.

THE USE OF CORNEAL CONTACT LENSES IN HIGH HYPEROPIA—A CASE REPORT*

Solon M. Braff†
Hollywood, California

CASE HISTORY

Ocular history: The patient, Mr. H. F. C., appeared for contact lens consultation May 6, 1950. He has worn a spectacle lens correction for 15 years and his current correction for seven years. A refraction of his eyes was made in Paris in 1947 but no change in correction was necessary at that time. He now wants contact lenses as he dislikes the "strong glasses" he must wear for visual comfort.

Health history: The patient is in excellent health. The only disease he remembers having is measles.

Family history: The patient was born in France of American parents. When the United States entered World War II he enlisted in the Army of the United States in France. After his discharge from the Army in 1948 he came to the United States for the first time. While in service both his parents died in France. They wore lenses and his eyes "were like my mothers."

School history: The patient attended school in France where he received an education equivalent to two years at the collegiate level. He is now a senior at the University of California at Los Angeles, majoring in business administration. He classes himself as a good student.

Occupation: Upon coming to the United States the patient visited Los Angeles where he shortly entered college. His income is derived from a legacy left him by his parents.

Social and recreational history: The patient's main avocational pursuits are swimming, reading and dancing, with major preference to none.

Complaint: The patient has no major visual complaint other than he wants a "check-up." He is very unhappy because "my heavy glasses don't look good and I get headaches when I don't wear them. I want the new contact lenses which only fit on the cornea."

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PRELIMINARY FINDINGS

External examination: The fissure and iris are of average size. The lid margins and the palpebral conjunctiva are a healthy pink as is the fornix. The bulbar conjunctiva and sclera are clear. The puncta are clear and apparently open. The iris is normally textured and the pupil margin is sharp and round. Slit lamp examination of the corneae indicate no opacities or lesions.

Pupillary reaction: Direct and consensual pupillary reaction to light is good as is that to accommodation.

Rotations and versions: There appear to be no restrictions to eye movements either monocularly or binocularly. The near point of convergence is 5 cm. with a deviation of the left eye at this point. The cover test reveals no apparent deviation of either eye.

OPHTHALMOSCOPIC AND OTHER TESTS FOR PATHOLOGY

The confrontation test shows full motion fields. Neither the ophthalmoscope nor the slit lamp reveal any opacities or other pathology within the refracting media. The fundi are medium red, the vessels course normally, the macular areas are clear and bright, the nerve head margins are distinct and there is a slight cupping of the discs.

ANALYTICAL EXAMINATION

Visual Acuity: Without Rx. R. 20/20. L. 20/20. Binocular V. A. 20/300. With Rx. R. 20/15. L. 20/15.

Current Correction: R. +5.00. L. +5.87.

Ophthalmometer: R. 41.75/180. 41.87/90. L. 41.50/180. 41.62/90.

Static Retinoscopy: R. +5.50. L. +6.50.

Dynamic Retinoscopy: R. +7.00. L. +8.00.

Subjective: R. +5.00. L. +6.00. V. A. 20/15. O. U.

Esophoria, ½ Δ. Hyperphoria, 0.

Adduction, 8/4. Abduction, 5/4.

Accommodative Overconvergence 1Δ.

Positive Fusional Reserve, 20/14.

Negative Fusional Reserve, 19/15.

Positive Relative Accommodation, —2.75.

Negative Relative Accommodation, +3.00.

Cross cylinder, fused, R. +7.25. L. +8.25.

Gradient, 1Δ Accommodative insufficiency /+2.25.

Positive Fusional Reserve, 6/2.

Accommodative Amplitude, R. 7.75. L. 7.50.

ANALYSIS OF FINDINGS AND PROCEDURE

The fissure-iris relationship and the patient's sincere desire and psychological acceptance of corneal lenses will stand him in good stead for the application of corneal lenses to his eyes. Of interest in this case is the effect of relatively high degrees of accommodation on single binocular vision. Monocularly, the patient is able to overcome approximately 5.00 D. and 6.00 D. of hyperopia in order to achieve acuity of 20/20 but binocularly acuity is reduced to 20/300— because of the inability to overcome the over-convergence associated with accommodation even though fusion is maintained.

The static, dynamic and esophoric findings all indicate a greater acceptance of plus power over subjective findings. Although the patient complains of no visual discomfort with his current correction, this condition is understandable in view of the relatively high degree of accommodative amplitude and the low esophoria he need overcome. However, because of the overconvergence associated with accommodation at both distance and near the correction advised for constant wear and adapted in his corneal lenses is, R. +5.25 D. Sph. L. +6.25 D. Sph.

The patient returned for several fitting visits and has received his corneal lenses. In several progress reports he has made since getting the lenses he claims that he wears them during all waking hours with complete visual comfort and good acuity.

1574 CROSS ROADS OF THE WORLD
HOLLYWOOD 28, CALIFORNIA

ABSTRACTS

DRUGS USED IN THE EYE. Harold G. Noyes (Dept. of Optometry, Columbia University, N. Y.). The Columbia Optometrist. 25 (97), 2-3, February, 1951.

This article summarizes briefly some of the drugs currently used for allergic eye disturbances; for preventive purposes (tetanus, typhoid, cowpox, smallpox, etc.); for tonics or restoratives (vitamins and glandular derivatives); and, he discusses the effects of special physical agencies, such as radioactive modalities. Relative to the latter, the author suggests that optometrists (as practical physicists) should cooperate with other specialists on research projects concerning ocular changes due to radiant energy.

The control of the pupil and of the ciliary muscle with miotics, mydriatics and cycloplegics is reviewed and the mode of action of various drugs employed for these purposes is discussed.

R. E. B.

RELATION OF FATIGUE TO TIME AND MOTION STUDY*

William W. Bruere†
Trenton, New Jersey

Motion and time studies are tools of equal importance to management and labor, while fatigue is the ever present efficiency-reducing factor. The relationship between effort expended and fatigue may not be in direct proportion, however, there is a ratio existing in this relationship.

Motion study is used to determine, by detailed investigation and close analysis of materials, tools and method, the correct way a given operation should be performed.

Time study is the accurate timing and recording of a specific operation to determine the time it takes a normal operator, working at a normal pace, to accomplish a definite task.

Fatigue, by definition, is a condition produced by excessive activity of the muscles or brain, which can be reduced by rest or change. A certain amount of work can be done at a rapid speed, but gradually the volume and quality decline. If the task is continued in spite of these evidences of fatigue, a state of exhaustion is reached.

Time study, as such, was first introduced in the United States by Frederick Winslow Taylor in Philadelphia at the Midvale Steel Company in 1881. His studies were entirely different from those heretofore taken in Europe by M. Perronet in 1760 and later by Charles Babbage in 1830. The time studies taken in Europe by Perronet and Babbage were based on over-all time, covering several hours of continuous work, while those taken by Taylor were quite revolutionary; they were subdivided into small groups of motions or elements.

In introducing his work Taylor stated, "Time study is the one element in modern scientific management beyond all others making possible the transfer of skill from management to men."

Motion study, as used today, was first sponsored by Frank B. Gilbreth and his wife, Lillian, who after lengthy, painstaking study and close observation arrived at a series of motions that were found in all types of work. To give these motions a general name they used the

*Read before the New Jersey Chapter, American Academy of Optometry, Trenton, New Jersey, as one of a series of lectures on occupational optometry. For publication in the July, 1951, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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word "Therblig" which is "Gilbreth" more or less spelled backwards. The 18 basic Therbligs are as follows:

1.	Search	Eye turned as if searching.
2.	Find	Eye straight as if fixed on object.
3.	Select	Reaching for object.
4.	Grasp	Hand open for grasping object.
5.	Transport loaded	A hand with something in it.
6.	Position	Object being placed by hand.
7.	Assemble	Several things put together.
8.	Use	Word "use."
9.	Disassemble	One part of an assembly removed.
10.	Inspect	Magnifying lens.
11.	Pre-position	A ten pin which is set up in a bowling alley.
12.	Release load	Dropping content out of hand.
13.	Transport Empty	Empty hand.
14.	Rest for overcoming fatigue	Man seated as if resting.
15.	Unavoidable delay	Man bumping his nose unintentionally and requiring attention.
16.	Avoidable delay	Man lying down on job voluntarily.
17.	Plan	Man with his fingers at his brow, thinking.
18.	Hold	Magnet holding iron bar.

To better evaluate the relation of fatigue to time and motion study it might be well to briefly review the events that lead us to our present industrial status. It is very difficult to imagine in this dependent era, that early man lived nearly independently. Early man realized that to survive, there were certain things he must develop, design and produce. It was a necessity to procure food, to build suitable protection from nature's elements, to design and manufacture his clothing, implements, furniture and weapons. It is logical to assume that eventually he realized that he was more adroit in procuring or producing one given article and could dispose of this commodity easier and more advantageously than he could procure and dispose of other commodities. He then specialized in this chosen product and, if successful, it became a necessity to hire and teach others the manufacture of this specific type of merchandise. This was the beginning of our first factory, the forerunner of our present highly specialized manufacturing system as we know it today.

Fatigue was not considered a matter of great importance in early manufacturing. The idea seemed to be "the back is made for the burden." If a worker did not have sufficient endurance and stamina he was released. The best that could be hoped for by the industrial worker was that through gang work his lot would be made partially easier. Total unit productivity was not given the close attention it was to receive later; mass production was an entity to come in the future. The invention of various forms of machinery had great bearing on our general manufacturing improvement. It soon became apparent that it was less expensive and very much quicker to train a worker to do one part of an operation than to train him to do the complete operation. At this

time methods engineering began to make rapid strides, and with it, as a means of measuring productivity, time study became an important factor. Fatigue was recognized as one of the main drawbacks of productivity and means for fatigue reduction were placed into operation. Some of the evolved principles used in combating fatigue are:

1. Proper illumination.

a. The light must be adequate and of sufficient intensity; properly located to insure that it will come from the correct direction.

2. Reduction of noise, where possible.

a. Where possible the machinery should be segregated so that the noise produced affects as small a percentage of employees as possible.

3. Circular work place lay out.

a. Angled and abrupt changes in direction are more time consuming and fatiguing to the worker, while smooth even curved motions are more desirable and cause less fatigue.

4. Definite fixed locations.

a. Definite fixed location should be provided for all tools and materials used.

5. Proper chairs.

a. The chair should be adjustable, rigidly built, wood saddle seat, with a good back support.

6. The use of both hands simultaneously.

a. Where it is possible for the operator to use both hands simultaneously the operation is not only performed faster but with less physical effort expended.

7. Use best motion sequence and minimum motions.

a. Hand motions should be reduced to a minimum, which will eliminate muscular fatigue.

8. Slide parts into position and use momentum where possible.

a. Rhythm is developed and fatigue reduced.

9. Combine tools.

a. Two or more tools can generally be combined successfully.

10. Use gravity feed bins, gravity chutes and drop delivery.

a. The use of gravity will do much to relieve the operator of actual physical effort.

Mass production really came into being with the progressive assembly or production line. This method, the use of the production line, has made it possible for this country to turn out amazing quantities of material. The theory of the production line is not a new idea. After a fashion the Venetians used this method in the construction of ships; in Europe it was used under the names of chain work and gang work. However, it is generally recognized and conceded that the progressive production line, as we know it today, was first used in the Ford Plant at Highland Park in Michigan.

For the purpose intended, it would be best to consider motion and time study as one complete working unit, used as a method of developing time standards and arriving at normal performance time for all of the varied types of industrial manufacturing. The main tool used in apply-

ing this method is the decimal minute stop watch and the procedure is as follows:

1. Collect data.

a. Record all available information on the time study sheet.

2. Make a complete examination and analysis of existing methods.

a. Before recording the time study, a complete and detailed analysis of the job to be studied is made. The equipment is studied, the mechanical and manual elements considered. Any arrangements for improvement should be noted on the time study sheet.

3. Divide the total cycle operation into existing elements.

a. Constant elements.
b. Varied elements.
c. Separate external and internal elements.

4. Time the operation.
5. Apply the efficiency leveling factor.
6. Apply elemental fatigue allowance.
7. Establish external time.
8. Establish internal time.
9. Establish available idle time.
10. Determine production per hour.
11. Determine unit price.
12. Determine standard hours.
13. Prepare charts.

a. Operation process charts (following operator).
b. Flow process charts (following material).
c. Man and machine process charts.
d. Frequency charts.
e. Right and left hand charts.

14. File observation sheets and information for reference.

The proper allowance for fatigue that must be added to the normal time of the operation to compensate the operator for his expended effort presents a serious problem to the time study man. If general rules of thumb regarding fatigue allowance are closely analyzed it will be discovered that their true value is extremely negligible, and the ratio of error will, in many cases, be large enough to subtract substantially from the true value of the study. It has been previously stated that at one time factory work involved heavy physical effort. This condition generally does not exist today and fatigue cannot be figured on the basis of a condition that does not exist. In general, fatigue is evaluated by two distinctly different points of view, each party involved looking at the problem with a different perspective. Management points to modern lighting, color schemes, ventilation, proper heating, sanitary conditions, modern labor-saving machinery, conveyor systems, proper tools and tooling, as well as the fact that the work day and work week have been shortened to such a point that fatigue is no longer a condition to deserve

or merit serious consideration. Labor, on the other hand, points out that the need for speed and effort to feed the machines, the rapidity required to keep pace with the conveyor or assembly line, the dexterity of mind, hand and body forces them through a pace that is nearly impossible to maintain, hence, a large fatigue allowance is an absolute necessity. In short, management and labor view the problem of fatigue allowance from different perspectives and arrive at opposing conclusions. The time study man may also be inclined to use this allowance to his personal advantage. It may well be a cover-up for a loose or tight standard or a way to escape to hide his inability to properly apply the efficiency rating factor. To follow only one line of reasoning rigidly without giving merit to the provisions or thoughts of the other view can only lead to serious difficulties. To follow an idea that states, without very definite explanation, that the proper allowance for fatigue may range from five per cent to 25 per cent offers very little in the way of constructive application and most certainly leaves much to be desired.

In order to give general consideration to this problem a start can be obtained by listing some of the known causes of industrial fatigue and their remedies:

1. Physical demands of the job upon which the operator is working.

a. The remedy for fatigue caused by physical demands of the job largely depends on proper man placement, proper labor-saving equipment and allowed rest periods.

2. Monotony of the job.

a. By scheduling work changes the monotony of a given job will be greatly reduced.

3. Length of the work day.

a. Under the prevailing conditions in industry, the length of the work day does not cause excessive fatigue to the extent that it cannot be overcome readily if the operator is in good physical condition.

4. Length of the work week.

a. The time-and-one-half overtime pay system generally prohibits management from maintaining an excessive work week, but when it does resort to the overtime week the overtime remuneration received by the worker compensates him for the extra effort expended.

5. Temperature and atmosphere.

a. This problem can generally be corrected by the installation of proper equipment, such as air ducts, fans and cooling systems. However, if the condition cannot be overcome, additional rest periods must be granted to the worker.

6. Necessary working postures.

a. Correct method engineering can generally eliminate difficult working postures. If this is not possible a direct fatigue allowance must be made so that the strain enforced upon the worker is reduced.

7. Rapidity of motions and dexterity required.

a. Recognizing the fact, that to some operators, it is less fatiguing to work at a rapid pace than to work at a slow pace, the fatigue problem is greatly reduced by the proper man placement.

8. Noise and vibration.

a. This represents a serious problem as it is too often impossible to reduce noise and vibration. Again, the only solution is in proper man placement, since some workers are not bothered as much as others by noise, and in the granting of additional rest periods.

9. Accident hazard.

a. Correct safety equipment and competent safety engineering, will greatly reduce accident hazard. However, if the hazard cannot be reduced reasonably, care must be utilized in selecting the operator so that the job assigned is neither above or below his basic capacity.

10. Nervous irritations.

a. Nervous irritations are generally caused by improper working conditions, improper supervision, unsatisfactory financial remuneration or incorrect job placement.

11. Mental attitude including frustration.

a. Fatigue, developing from an improper mental attitude, produces disinterest in work, lack of attention or greatly reduced productive work. This condition is generally caused by a worker who has been assigned to a type of work that is above or below his basic capacity.

12. Eye strain.

a. Some of the causes for fatigue produced by eye strain can be improper lighting, improper color combinations, and faulty vision on the part of the operator.

The main problem of the time study man is not to formulate a series of percentages to offset fatigue, but rather to eliminate the causes of fatigue as much as is in his scope to do so. If he is successful in properly eliminating the causes of fatigue, the remaining efforts expended by the worker will be greatly diminished and the percentage for fatigue allowances will be reduced low enough to assure a reasonable degree of accuracy. If the time study man is to obtain a degree of accuracy within a still closer range, it will be essential that he receive help from psychologists, physicians and optometrists, all of whom until now have given very little constructive criticism.

All in all, the problem is extremely complicated but is gradually coming into some semblance of order if not of understanding. It is actually a problem for the physiologist and psychologist, and one which they have had indifferent success in solving in spite of their efforts. Although they do seem inclined to criticize the time study profession for its rough-and-ready approach, very little of their work is of any practical assistance. Fortunately, as we have already seen, the advance of mechanization is steadily reducing the margin for error as far as time study is concerned.

REFERENCES

Ralph M. Barnes, Motion and Time Study (New York, John Wiley and Sons, 1940) p. 7.

Ralph Presgrave, The Dynamics of Time Study, (New York, McGraw-Hill Book Company, Inc., 1945) p. 226.

DUO-CHROME STENCILS TO AID AMBLYOPES*

Israel Dvorine†
Baltimore, Maryland

It is the general practice of many refractionists to prescribe some form of handiwork for amblyopes whose low visual acuity is not due to an active pathology or is not of pathological origin. This type of amblyopia, while generally associated with strabismus, may also occur without any obvious deviation. Constant or intermittent suppression of vision of the amblyopic eye is the general rule. This suppression may be total, that is, both central and paracentral vision may be involved or central vision only.

In addition to periodic occlusion of the eye with the better vision, it is the standard routine to recommend to the patient that he engage in some form of manual activity during the occlusion, as a further aid to stimulate the visual reflex in the amblyopic eye and to increase the visual acuity. The more ingenious and enjoyable the task, the more likely is the patient to maintain interest in the exercise. Since the majority of the amblyopes are children ranging in ages from six to 12 years, their span of interest in any task is short, especially under the trying conditions of seeing with one eye whose visual acuity is low.

To maintain a high degree of motivation in these little patients, refractionists usually recommend tasks which would normally be of interest to them, such as, tracing pictures, stringing beads, connecting dot and dash drawings, arranging anagrams, assemblying jig saw puzzles, etc. These tasks and others of a similar nature are to be performed while the eye with the better vision is occluded.

A more complicated form of exercise, from a visual performance viewpoint, is the cheiroscopic drawing performed while both eyes are open, one eye viewing a picture, while the other eye sees a duplicate of it being drawn by the patient. The advantage of this form of visual exercise over other tasks designed to encourage the use of the amblyopic eye, is in the manner of making the drawing. The patient is forced to use both eyes simultaneously, or else alternate very rapidly from one eye to the other. Since the ultimate goals are single binocular vision, acuities nearly alike in both eyes, with wide amplitudes of fusion and a high degree of tridimensionality as the optimum accomplishment,

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†Optometrist, Fellow, American Academy of Optometry.

binocular training should be preferred, in preference to monocular training, with special emphasis on seeing with the amblyopic eye, especially if the fixation of the amblyopic eye is not eccentric.

This form of visual training is not new, having been first suggested by Maddox of England many years ago and further developed by Peckham and the Keystone View Company in this country. In its application, a special instrument is required, having a septum in the center to prevent the amblyopic eye from seeing the picture being viewed with the better eye.

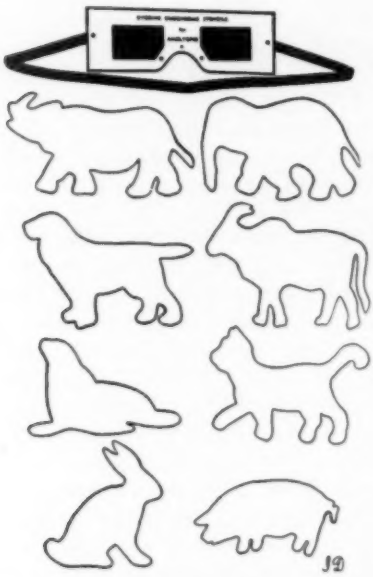
Another method, popular a few years ago, was a drawing outfit consisting of a number of simple drawings printed in light colored ink and a pair of paper spectacles having a red filter in one opening and a green filter in the other, with temples so arranged as to enable the patient to mount the spectacles either frontway or backwards, thus bringing either the red or green filter before the amblyopic eye. Its popularity with refractionists was short-lived because of two reasons: First, limitation of the number of drawings and second, the difficulty of keeping the spectacles on the patient's face.

The writer has searched for a means of improving this technique and to provide unlimited drawing material for home training in order to keep the young patients at this task long enough to improve the visual acuity of the amblyopic eye. The following is a description of the material recently designed by the author and which will be incorporated as part of his Animated Fusion Training Charts set.

The principal additions are a set of stencils and a duo-chrome holder. The stencils consist of eight simple cut-outs which can be used again and again to outline the figures of the animals. Thus, there is almost no limit to the number of drawings the child can make. When he tires of one drawing, he can readily change to another.

The improvement in the duo-chrome holder is in the elastic attachment which permits the holder to be placed before the eyes without slipping, while both hands are free to trace the drawing made from the stencil. The filters in the holder are red and blue, the colors having been selected to complement the particular colored pencil which the patient must use. In addition to the colored pencil, a black crayon is included to provide the last step of the completed drawing. The duo-chrome holder is so constructed as to permit it being reversed, if desired, to bring either filter before the right or left eye. The complete technique is as follows:

Having made certain that fixation with the amblyopic eye is normal and that its eye movements are not restricted, the doctor selects



for the patient (in order to demonstrate the procedure) one of the stencils and lets the patient outline the selected figure with the *blue* pencil on a white sheet of paper. The duo-chrome holder is then placed on the patient, over the regular eyeglasses if habitually worn, keeping the *red* filter before the eye with the poorer vision.

The effect of the filters is such as to completely eliminate or make invisible the blue drawing being viewed through the blue filter by the eye with the better vision and at the same time make the drawing more vivid before the amblyopic eye than in its original form, as a result of it being seen through the red filter. The patient then traces his own drawing with the black crayon provided for this purpose.

In addition to the value of fixing the blue drawing with the amblyopic eye and following the tracing of its outline with the black crayon, there is the added effect of seeing the black outline with the better eye, while the amblyopic eye is engaged in a visual performance. Although the original blue drawing is visible through the duo-chrome holder to one eye only, the black tracing becomes visible to both eyes at the same time. Thus in one performance, there is a shifting of visual dominance to the amblyopic eye and the perception of like images is simultaneous

with both eyes.

Having demonstrated the technique to the patient or to the adult accompanying the child, the doctor should instruct the patient to repeat this exercise at home daily, making several drawings instead of one, using different stencils from the set each time to provide interest and variety and thus keep motivation high.

SUMMARY

1. The author describes a set of stencils which he designed to provide unlimited drawing material for amblyopic patients to trace, and an inexpensive duo-chrome holder with an elastic band to leave both hands free to make the tracing.

2. A technique is outlined, making use of a blue pencil and a black crayon, to provide simultaneous binocular perception with dominant fixation being maintained by the amblyopic eye in order to eliminate suppression and to improve visual acuity resulting from non-use of the eye.

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ABSTRACTS

NEW CONTACT LENSES. Samuel W. Silverstein. The Columbia Optometrist. 25 (97). 6-7. February. 1951.

The author states that a satisfactory contact lens, insofar as the patient is concerned, must provide "comfort, vision, invisibility and constant wearability." He reports that while the recently-introduced small corneal lens has provided certain advantages over the larger, solution-type lens, it is not entirely successful.

The author has developed a "vented lens" which he states combines the benefit of both the full-sized and the corneal wafer type lenses by providing adequate tear drainage and elimination of haze. The "vented lenses" are full-sized stock lenses adjusted to the eyes so that a minimum solution lens is formed over the apex and perforations are then added. When some tolerance has been attained, the refractive correction is incorporated on the outside corneal curve.

A selected number of practitioners have been fitting the "vented type lens" with gratifying success.

R. E. B.

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A NATIONAL EXAMINING BOARD IN OPTOMETRY

The question of a national examination, and reciprocity for optometrists, has been before the profession for years. During this period a number of suggestions have been made to augment the present activities of our state board of examiners in optometry to the end that both registration and reciprocity be placed on a more uniform basis throughout the states.

At the annual meeting of the American Optometric Association at New Orleans the International Association of State Board of Examiners

in Optometry, working in conjunction with the A. O. A. Board of Trustees and the Association of Optometric Schools and Colleges, took the initial steps to create a national examining board for optometry.

In order to have a national examining board in which all have confidence, it will be necessary to use qualified educators who will plan, prepare, conduct and grade examinations given to applicants. There are factors, however, which must be taken into consideration in developing an activity of this kind.

The newly created examining board should at its earliest opportunity examine candidates, even though the national board is as yet unrecognized in any existing state optometric regulatory statute. The board should be functioning and in complete operation before amendments are proposed to existing optometric laws permitting individual state boards to recognize candidates who have been qualified for registration by the national board.

It must be recognized in optometry that a national board could have no authority to issue a license to an optometrist which would enable him to practice optometry. As the writer has pointed out,[1] this may only be done by the states as the power of licensure in the various professions is reserved to the states under our constitution.

Once the national examining board in optometry is functioning it will be necessary for each state to amend its optometric practice act giving its own board of optometric examiners authority to accept the national examination in lieu of its own. To achieve this end, the requirements for admission to a national examination must be as high as those now required by our state boards and the examination itself must be of such caliber that individual state boards would favorably consider accepting approved national examination candidates.

All schools of optometry are now on a university basis, having adopted a five-year curriculum and this minimum standard of professional training which applies equally throughout the entire country establishes a uniform base upon which the national board of optometric examiners can work. The establishment of this national board is an important and vital step in the further development of optometry.

This board should be selected with the greatest of care and its administrative functions should be conducted along lines which parallel the very best in education.

As proposed at New Orleans the examinations will be conducted annually at our schools and colleges, the graduating class being permitted

[1]Carel C. Koch. National Registration and Reciprocity. Am. J. Optom. & Arch. Am. Acad. Optom. 22.2.85-90. 1945.

to take the tests. The uniform tests will be monitored and the examination papers will be returned to the national examining board for grading.

The plan adopted provides for uniformity in examining and grading of applicants and should do much towards simplifying the existing registration and reciprocity provisions of our individual state optometry acts.

This action at New Orleans is most significant and if carried out properly deserves the fullest support of all segments of the profession.

CAREL C. KOCH

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

NEW ACADEMY MEMBERS

The following optometrists and educators have been elected to Fellowship in the American Academy of Optometry. The Academy welcomes these new members.

Dr. Merrill J. Allen, School of Optometry, The Ohio State University, Columbus, Ohio.

Mr. Albert J. Billson, 5 Newmarket Street, Ayr, Scotland.

Mr. Albert S. Billson, 5 Newmarket Street, Ayr, Scotland.

Mrs. Mary M. Billson, 5 Newmarket Street, Ayr, Scotland.

Mr. G. A. Brock, 32 Eagle Road, Brislington, Bristol, England.

Dr. M. E. Broom, Southern College of Optometry, 865 Washington Avenue, Memphis, Tennessee.

Mr. S. G. Burnley, Borough Chambers, Hinckley, Leicestershire, England.

Dr. Darrell B. Carter, 918 Gilman Street, Apartment 6, Berkeley, California.

Dr. Henry J. Frank, Chicago College of Optometry, 1849 North Larrabee Street, Chicago, Illinois.

Mr. H. Freeman, 493 Roman Road, London, E. 3, England.

1st Lt. William A. Greensides, U. S. A. F. (MSC) Station Hospital, Travis AFB. Fairfield, California.

Mr. Humphrey Hughes, 26 West Street, Pontypridd, Glamorgan, England.

Mr. John Griffith Jones, 2 St. John Street, Deansgate, Manchester, England.

Dr. Henry A. Knoll, Los Angeles College of Optometry, 950 West Jefferson Boulevard, Los Angeles, California.

Dr. C. F. Mackey, South Van Rensselaer Street, Rensselaer, Indiana.

Dr. John Earl Martin, 201-202 Masonic Building, Carroll, Iowa.

Dr. William W. Smith, 1014 First National Bank Building, Atlanta, Georgia.

Dr. D. R. E. Waters, 302-305 Muckentholer Building, Santa Ana, California.

COMMITTEE APPOINTMENTS

SECTION ON OCCUPATIONAL OPTOMETRY

Dr. Harold Simmerman, president of the American Academy of Optometry announces the following appointments to the Academy's new section on occupational optometry:

Dr. Richard Feinberg, Chairman, School of Optometry, Pacific University, Forest Grove, Oregon; Dr. C. S. Bridgman, Madison, Wisconsin; Dr. L. Wayne Brock, Greenville, South Carolina; Mr. Sylvester K. Guth, East Cleveland, Ohio; Dr. Richard M. Hall, Cleveland, Ohio; Dr. W. J. Heather, Southbridge, Massachusetts; Dr. Herman Sager, Lake Success, New York; Mr. R. A. Sherman, Rochester, New York; Dr. Donald A. Springer, Anniston, Alabama; Commander R. Roswell Sullivan, Washington, D. C., and Dr. Lee M. Wheless, High Point, North Carolina.

LOCAL CHAPTER ACTIVITIES

FLORIDA CHAPTER

The Florida chapter of the Academy at its annual meeting in June elected the following officers to serve for the coming year: Dr. W. C. Kennedy, Sarasota, president; Dr. A. C. Haughton, West Palm Beach, vice president; Dr. H. C. Bumpous, St. Petersburg, secretary-treasurer; Dr. K. K. Eychaner, Tampa and Dr. Esther McQuarrie, executive council. Speaker at the meeting was Dr. Harry Pine, Chicago, Illinois.

SAN FRANCISCO BAY AREA

Dr. Elwin Marg and Dr. Henry B. Peters, members of the staff of the School of Optometry, University of California were the speakers at the May meeting of the San Francisco Bay Area chapter. Dr. Marg discussed, "Voluntary Versus Reflex Accommodation," and Dr. Peters, "Industrial Vision."

ILLINOIS CHAPTER

Illinois Chapter members met in Freeport, Illinois, for their June meeting.

EASTERN PENNSYLVANIA CHAPTER

Officers and executive council members elected by the Eastern

Pennsylvania Chapter are as follows: President, Dr. Gordon W. Venable, Philadelphia; Dr. Edwin H. Manwiller, Philadelphia, vice president; Dr. William G. Walton, Jr., Merion, secretary-treasurer; Drs. Lawrence Fitch, L. Garns and O. Rybachok, Philadelphia, council members.

SOUTHERN CALIFORNIA CHAPTER

Industrial vision was the topic of the evening for Southern California chapter members in June. Dr. Joseph Ziff presented a paper, "The Role of the State in Industrial Safety and Production," and Mr. McKay Mitchell, industrial engineer, California State Industrial Safety Commission, spoke on "Emphasis on Vision."

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

NEW ORLEANS NOTES

Over for another year is a successful Congress of the American Optometric Association. At the meeting in New Orleans June 24-28, Dr. J. Ottis White was re-elected president, Dr. James Wahl, Anna, Illinois, first vice president; Dr. Lawrence H. Foster, San Jose, California, second vice president; Dr. Joseph M. Babcock, Portsmouth, Ohio, third vice president; Dr. Norman B. Hays, Niagara Falls, New York, fourth vice president; Dr. S. L. Brown, Fostoria, Ohio, treasurer, and Dr. Ernest H. Kiekenapp, Minneapolis, Minnesota, secretary. Taking past president Dr. John B. O'Shea's place as trustee is Dr. Leo G. Miller, Lincoln, Nebraska.

Among the significant actions taken by the A. O. A. were:

A representative of the Association of Optometric Schools and Colleges was placed on the A. O. A. Council on Education and Professional Guidance. (This action should strengthen the Council.)

The resignation of Dr. H. Ward Ewalt, chairman, Council on Educational Professional Guidance, was accepted, with regret. Dr. Ewalt, who has served for many years as chairman, will be succeeded by Dr. William Greenspon, Bluefield, West Virginia.

Approval of an increase in dues for all A. O. A. members from $15.00 to $20.00 a year was voted. (House of Delegates action.)

Miami, Florida, was chosen as the 1952 Congress City.

The Association of Schools and Colleges of Optometry, which met concurrently with the A. O. A. Congress, elected the following new officers: Dr. Kenneth B. Stoddard, School of Optometry, University of California, president; Dr. Ralph Green, Massachusetts College of Optometry, secretary-treasurer; Dr. Henry Hofstetter, Los Angeles College of Optometry, member of executive committee. The association withheld consideration of extending optometric professional study to six years. Three optometric colleges are now giving serious thought to this proposed change.

The International Association of State Boards of Examiners in Optometry approved a plan to set up a national examining board for optometry. This board to function with the cooperation of the A. O. A. and the Association of Schools and Colleges.

Two outstanding leaders in the visual care field were presented with the Beta Sigma Kappa gold medal for their contributions to the "visual welfare of the people," at the recent A. O. A. convention. Dr. H. Ward Ewalt, Pittsburgh, and Dr. Otis R. Wolfe, director, Eye Clinic, Deaconess Hospital, Marshalltown, Iowa, were the recipients of the medals, which were presented by Dr. Harry Pine, Chicago.

The Optometric Foundation also held its annual meeting. The Advisory Council comprised of representatives of optometric colleges recommended that an informative bulletin be distributed quarterly by the Foundation advising optometrists of the progress made on the Foundation's research projects now being conducted in the schools. This action was approved by the officers and trustees, all of whom were re-elected. Dr. W. C. Ezell of Spartanburg, South Carolina, is president.

CAMPUS NEWS

Southern College of Optometry conferred Doctor of Optometry degrees on 42 candidates June 22, at its commencement. Graduating students came from 19 states. The commencement address was given by the Honorable Blanchard S. Tual, attorney at law from Memphis, Tennessee.

Chicago College of Optometry opens its doors July 23 for its 1951 postgraduate seminars for practicing optometrists. There will be a one-week general seminar and a one-week special seminar. Doctors may register for either or both. The latest developments, techniques and principles of optometry will be covered in lectures, laboratory sessions and group discussions. Dr. Thaddeus R. Murroughs, director of research for the college will be in charge.

One hundred and forty-five students of Los Angeles College of Optometry received the Doctor of Optometry degree at Spring commencement in Thorne Hall, Occidental College, Los Angeles. Dr. Ernest A. Hutchinson, president, conferred the degrees and introduced the commencement speaker, Donald S. Howard, dean, school of social welfare, University of California.

At the recent dedication of the new building housing the School of Optometry, The Ohio State University, a special honor was conferred on Dr. Herbert Mote, Columbus, Ohio. An engraved gold key to the front entrance of the new building was presented to Dr. Mote in recognition of his long and outstanding service to the School of Optometry. He is a member of the faculty, Fellow of the American Academy of Optometry, and past president of the Ohio Optometric Association.

More than 700 active members now constitute the Alumni Association of the Northern Illinois College of Optometry according to Dr. Philip Jackman, Hackensack, New Jersey, President of the Association. The group met for a special meeting during the A. O. A. Congress at New Orleans.

FELLOWSHIPS IN DRIVING RESEARCH

Fellowships for those interested in driving research are now being made available by the Allstate Insurance Company of Chicago, through the Driving Laboratory, Iowa State College. Both graduate and undergraduate fellowships are available for from $540.00 to $1,125.00, and nine to 12 months' study. Applicants with backgrounds in psychology, bio-physics, engineering, statistics, or mathematics will be given preference. Applications should go to Dr. A. R. Lauer, Professor of Psychology, Director of Driving Laboratory, Industrial Science Research Institute, Iowa State College, Ames, Iowa.

OPTOMETRISTS IN THE NEWS

Dr. Gordon Walls, professor of physiological optics, school of optometry, University of California, Berkeley, will lecture at the coming San Jose Visual Training Workshop in August. He will discuss "The Common Sense Horopter." At the same meeting Dr. Louis Jaques, Los Angeles, and Dr. G. N. Getman, Luverne, Minnesota, will also speak.

Honored recently by the United Jewish Welfare fund, Los Angeles, is Dr. Joseph Ziff, Los Angeles. He was presented at a banquet with an inscribed bronze plaque by the agency for outstanding service in fund-raising activities.

Among the new directors of the Better Vision Institute, elected at the annual meeting in New York in June, are Dr. Walter I. Brown, New Bedford, Massachusetts; Dr. E. C. Nurock, Trenton, New Jersey; Dr. John J. O'Neil, Springfield, Massachusetts. Elected to the finance committee, Dr. Jesse Wheeler, Hartford, Connecticut; named divisional director, Dr. John B. O'Shea, Northampton, Massachuetts; elected to the executive committee, Dr. Walter I. Brown; named director-at-large, Dr. J. Ottis White, Baton Rouge, Louisiana.

Dr. Julius Neumueller, Haddonfield, New Jersey, and faculty member of Pennsylvania State College of Optometry, is touring Europe this summer—"just for relaxation."

Dr. O. H. Johnson, Jonesboro, Arkansas, was honored with a plaque by the Northeast Arkansas Optometric Society at its Spring meeting, in recognition of his 38 years of practice—the longest of any member in the Society. Dr. Johnson is a Fellow of the American Academy of Optometry, past president of the Arkansas Optometic Association, member of Beta Sigma Kappa Fraternity, member of the Society for Strabismic Research.

NORTH CAROLINA MOTORISTS TO GET ORTHO-RATER TEST

North Carolina's motor vehicle licensing division has put Bausch & Lomb's Ortho-Rater to use for the first time. Starting July 1, training for 120 licensing examiners began in the use of the instrument for testing visual skills connected with driving. In the future, applicants for drivers' licenses will be tested with the ortho-rater in an effort to catch drivers with poor vision who have slipped by with former testing methods. Applicants who fail the test will be advised to see an eye specialist.

NEW ANISEIKONIA DIRECTORY READY

Dr. Robert E. Bannon, secretary of the Aniseikonic Forum, announces that a new directory of aniseikonic practitioners is now available upon request. Dr. Bannon is now with the Bureau of Visual Science of the American Optical Company and mail should be addressed to him in care of the Bureau, Southbridge, Massachusetts.

NEWS BRIEFS

An attempt during the recent A. M. A. convention in Atlantic City to rescind the resolution passed in 1950 permitting professional cooperation between ophthalmologists and optometrists failed. This attempt did not have the support of the majority of ophthalmologists present and at their request was defeated by the A. M. A. House of

Delegates. . . . A portable optometric exhibit publicizing and interpreting the value and importance of optometric services was featured at the 48th annual meeting of the New Jersey Optometric Association. The exhibit was designed for use at public affairs in schools, libraries, etc., and if interest is high enough on the part of optometric associations and societies, the N. J. O. A. will try to make available replicas for use by these groups. Address inquiries to Dr. Andrew F. Fischer, Executive Secretary, New Jersey Optometric Association, 162 West State Street, Trenton 8, New Jersey. (The exhibit is sectional and can be mounted on tables or in booths.) . . . Something new under the sun: See-Lector sunglasses, featuring adjustable polaroid lenses and Tenite plastic frames. The wearer looks through two sets of light control lenses—one stationary, one rotatable with five graduations of light control. Manufactured by Pioneer Scientific Corporation. . . . Thomas H. Morse was named president of Bay State Optical Company at its recent board of directors meeting. . . . Named assistant to the president of Soft-Lite Lens Company at its board of directors meeting was Joseph J. Margules, who has been associated with the firm's export division. . . . The National Society for the Prevention of Blindness is now on record as favoring the continued use of 1 per cent silver nitrate solution as the "preferred prophylactic agent in preventive treatment of ophthalmia neonatorum." The Society, according to Dr. Franklin M. Foote, executive director, felt additional scientific research is needed before penicillin can be accepted as a safe and adequate substitute. . . . Dr. M. A. Marvelli, Eau Claire, Wisconsin, was elected president of the Wisconsin Optometric Association in June. . . . Re-elected president of the Northern Illinois College of Optometry Alumni Association—Dr. Phillip Jackman, Hackensack, New Jersey. . . . On hand at the International Optical Congress in London this month, from the United States were Nathaniel Singer, President, Soft-Lite Lens Company, Martin Topaz, Editor, *The Optometric Weekly*, and Dr. John Neill, Philadelphia, faculty member of Pennsylvania State College of Optometry, and official representative at the Congress of the American Academy of Optometry. Dr. Reuben Seid, President of Chicago College of Optometry, had also planned to attend the Congress, but was prevented from going at the last minute by illness.

The True Facts of Lite About Sunglasses

The GOGGLE-ITIS* attack is at its height! Millions of people are buying sunglasses. Many are reliable refractionists' patients who wouldn't think of 10c store white lenses. Here is a fertile field for patient education, which begins in the refracting room or over the dispensing table.

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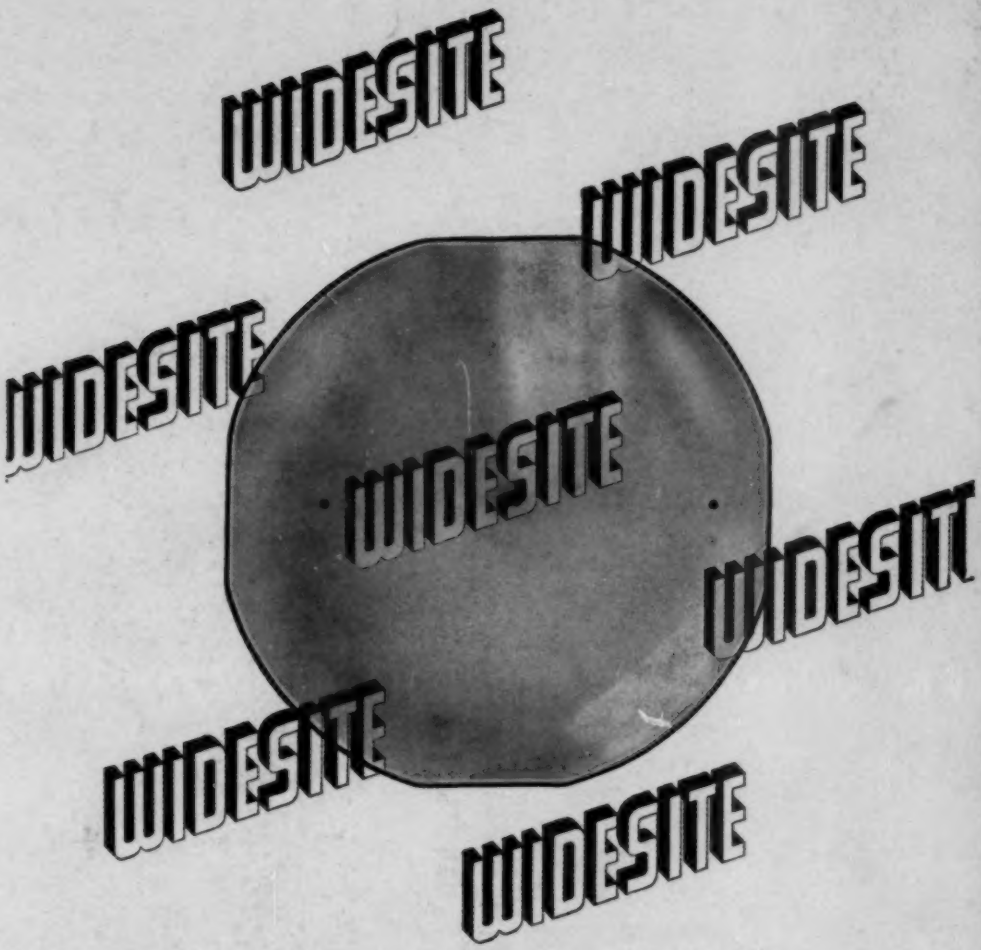

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